TA320
Time Interval Analyzer
USER'S MANUAL

IM 704210-01E
1st Edition

User's Manual

Model 704210
TA320
Time Interval Analyzer

Notice of Alterations

Please note the following alterations(with under line) to the IM704210-01E.

- **Page 3 "Checking the Contents of the Package"**

Optional Accessories

Part Name	Part No.	Minimum Q'ty	Remarks
150MHz probe	700998	1	Input impedance: 10MΩ, Length: 1.5 m
:	:	:	(10:1, 1:1 selectable)
:	:	:	:

- **Page 4 "Safety Precautions"**

The following symbols are used in this instrument.

To avoid injury, death of personnel or damage to the instrument, the operator must refer to an explanation in the User's Manual or Service Manual.

Alternating current

ON(power)

OFF(power)

In-position of a bistable push control

Out-position of a bistable push control

- **Page 11-19 "11.7 Circuit Breaker"**

Note

The fuses inside the case can not be replaced by user. If you believe the fuse is blown, please contact your nearest YOKOGAWA representative listed on the back cover of this manual. The ratings of the fuses used inside the case are indicated below.

Location	Rating	Type	Certified Standard
Power Supply Unit(F1*)	250 V, 3 A	Time lag	UL/CSA
	or 250 V, 3.15 A	Time lag	VDE

*: Alternatively use

- **Page 12-1 "12.1 Measuring Inputs and Trigger"**

Items	Specifications
:	:
Maximum input voltage	: •{3.5/f(MHz) + 5} V (DC + AC_{peak})(100 kHz < input frequency ≤ 100 MHz) •Overvoltage category : CAT I and II
:	:

- **Page 12-9 "12.10 General Specifications"**

  Addition of specifications

Item	Specifications	
EMC	Certified by KEMA	
	Environment	Residential, commercial, light industry and industrial.
	Standard(s)	
	IEC 1326-1:1994(draft)	EMC requirements for electrical equipment for measurement, control and laboratory use, from which:
	CISPR 22:1993	Emission class B
	IEC 801-2:1991	Electro Static Discharge immunity
	IEC 801-3:1988	EM-field immunity
	IEC 801-4:1988	Electrical Fast Transient immunity
	IEC 1000-4-5:1995	Surge transient immunity
	IEC 1000-4-6:1996	HF conducted immunity
	IEC 1000-4-11:1994	AC voltage interruptions
	EN 50082-2:1995	Generic immunity standard, from which:
	EN 61000-4-2:1995	Electro Static Discharge immunity
	ENV 50140:1993	EM-field immunity
	EN 61000-4-4:1995	Electrical Fast Transient immunity
	EN 61000-4-5:1995	Surge transient immunity
	ENV 50141:1993	HF conducted immunity
Safety	Complying Standard :EN61010-1	
	Overvoltage Category II	
	Pollution Degree 2	
Standard operating conditions	:	
Operating altitude	2000 m or below	
Warm up time	:	
:	:	

Foreword

Thank you for purchasing the YOKOGAWA TA320 Time Interval Analyzer.
This user's manual contains useful information about the functions and operating methods of the instrument. It also contains precautions that should be observed during use. To ensure correct use of the instrument, please read this manual thoroughly before operating it.
Keep the manual in a safe place for quick reference whenever a question arises.
The following manual is provided with this instrument in addition to this manual.

Manual Name	Manual No.	Description
TA320 GP-IB Interface User's Manual	IM704210-12E	Describes the communication functions for the GP-IB interface.

Notices

- The contents of this manual are subject to change without prior notice as a result of improvements in the instrument's performance and functions. Display contents illustrated in this manual may differ slightly from what actually appears on your screen.
- Every effort has been made in the preparation of this manual to ensure the accuracy of its contents. However, should you have any questions or find any errors, please contact your nearest YOKOGAWA representative as listed on the back cover of this manual.
- Copying or reproduction of all or any part of the contents of this manual without YOKOGAWA's permission is strictly prohibited.

Trademarks

- MS-DOS is a registered trademark of Microsoft Corporation.
- HP-GL is a registered trademark of Hewlett-Packard Company.

Revisions

- 1st Edition : December 1996

Disk No. HF07
1st Edition: December 1996 (YG)
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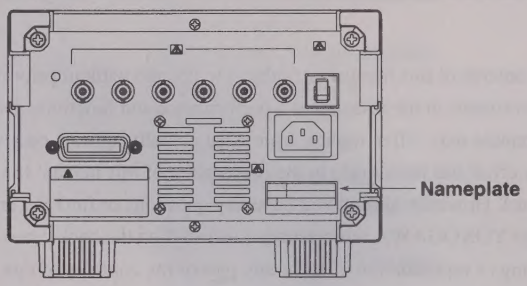
Checking the Contents of the Package

Unpack the box and check the contents before operating the instrument. If the wrong instrument or accessories have been delivered, if some accessories are missing or if they appear abnormal, contact the dealer from which you purchased them.

Main Body

Check that the model name and suffix code given on the name plate of the rear panel match those on your order.



MODEL (Type Name)

704210

SUFFIX (Suffix Code)

Item	Suffix Code	Specifications
Power voltage	•••••••••••••••••••	100-240 VAC
Power cord	-D	UL/CSA Standards Power Cord (Part No.: A1006WD) [Maximum Rated Voltage: 125 V, Maximum Rated Current: 7 A]
	-F	VDE Standard Power Cord (Part No.: A1009WD) [Maximum Rated Voltage: 250 V, Maximum Rated Current: 10 A]
	-Q	BS Standard Power Cord (Part No.: A1054WD) [Maximum Rated Voltage: 250 V, Maximum Rated Current: 10 A]
	-R	SAA Standard Power Cord (Part No.: A1024WD) [Maximum Rated Voltage: 240 V, Maximum Rated Current: 10 A]

NO. (Instrument No.)

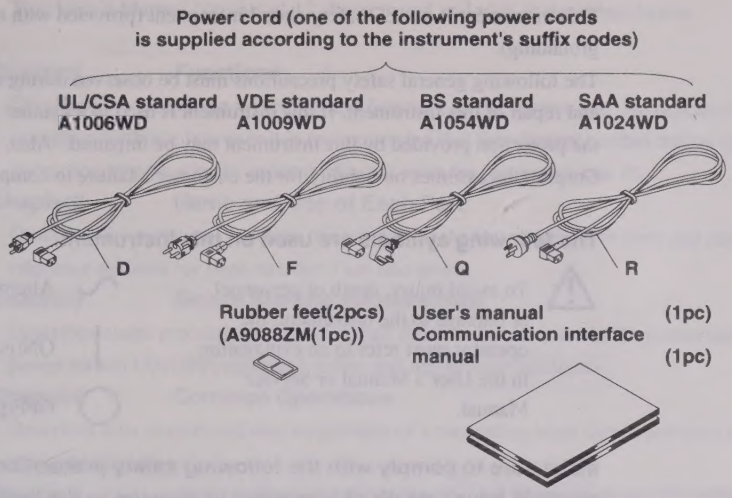
When contacting the dealer from which you purchased your instrument, please quote the instrument No.

Note

It is recommended that the packing box be kept in a safe place. The box can be used when you need to transport the instrument somewhere.

Standard Accessories

The following standard accessories are supplied with the instrument. Make sure that all items are present and undamaged.



Optional Accessories

The following optional accessories are available. On receiving these optional accessories, make sure that all the items that you ordered have been supplied and that they are undamaged.
If you have any questions regarding optional accessories, or if you wish to place an order, contact the dealer from whom you purchased them.

Part Name	Part No.	Minimum Q'ty	Remarks
150 MHz passive probe	700996	1	Input impedance: 10 MΩ, Length: 1.5 m
BNC cable (1m)	366924	1	BNC-BNC, Length: 1 m
BNC cable (2m)	366925	1	BNC-BNC, Length: 2 m
Rack-mount kit	751533-E3	1	For EIA single mount
Rack-mount kit	751534-E3	1	For EIA dual mount
Rack-mount kit	751533-J3	1	For JIS single mount
Rack-mount kit	751534-J3	1	For JIS dual mount

Safety Precautions

This instrument is an IEC safety class I instrument (provided with terminal for protective grounding).
The following general safety precautions must be observed during all phases of operation, service and repair of this instrument. If this instrument is used in a manner not sepecified in this manual, the protection provided by this instrument may be impaired. Also, YOKOGAWA Electric Corporation assumes no liability for the customer's failure to comply with these requirements.

The following symbols are used on this instrument.

To avoid injury, death of personnel or damage to the instrument, the operator must refer to an explanation in the User's Manual or Service Manual.

Alternating current.

ON(power).

OFF(power).

Make sure to comply with the following safety precautions. Not complying might result in injury, death of personnel or damage to the instrument.

WARNING

Power Supply

Ensure the source voltage matches the voltage of the power supply before turning ON the power.

Power Cable and Plug

To prevent an electric shock or fire, be sure to use the power cord supplied by YOKOGAWA. The main power plug must be plugged in an outlet with protective grounding terminal. Do not invalidate protection by using an extension cord without protective grounding.

Protective Grounding

Make sure to connect the protective grounding to prevent an electric shock before turning ON the power.

Necessity of Protective Grounding

Never cut off the internal or external protective grounding wire or disconnect the wiring of protective grounding terminal. Doing so poses a potential shock hazard.

Defect of Protective Grounding and Fuse

Do not operate the instrument when protective grounding or fuse might be defective.

Do not Operate in an Explosive Atmosphere

Do not operate the instrument in the presence of flammable liquids or vapors. Operation of any electrical instrument in such an environment constitutes a safety hazard.

Do not Remove any Covers

There are some areas with high voltages. Do not remove any cover if the power supply is connected. The cover should be removed by qualified personnel only.

External Connection

To ground securely, connect the protective grounding before connecting to measurement or control unit.

Structure of the Manual

This User's Manual consists of 12 chapters and an Index as described below.

Chapter1 Functions

Describes the measuring principles and functions of the instrument. No description is given for operating methods, however it is recommended that this chapter be read before operating the instrument to gain a basic understanding of what the instrument can do.

Chapter2 Name and Use of Each Part

Describes the name and function of each part of the instrument. For keys and rotary knob, reference sections (or page numbers) are also given.

Chapter3 Before Starting Measurement

Describes usage precautions, how to install the instrument, connect the power cord, turn the power switch ON/OFF, connect a probe and set the date and time.

Chapter4 Common Operations

Describes how to start and stop acquisition of a measuring input signal and set a numerical value using the ten-key.

Chapter5 Setting the Sampling Mode and Measurement Function (Item)

Describes how to set the sampling mode and measurement function (item).

Chapter6 Setting the Acquisition Conditions for Input Signal to be Measured

Describes how to set the acquisition conditions for the input signal to be measured, including input coupling, input impedance, trigger mode and trigger level, gate type, sample size and sampling interval, arming source, slope, delay types, and inhibit.

Chapter7 Displaying the Measured/Computed Data

Describes how to display a histogram, time variation, list of measured data and statistic values, and how to set multi-window, panorama display and histogram data addition functions.

Chapter8 Storing and Recalling the Set-up Information from the Internal Memory

Describes how to store the set-up information to the internal memory and how to recall the stored set-up information and change it.

Chapter9 Saving and Loading the Data from a Floppy Disk

Describes how to save data such as set-up information, measured/computed results and screen image to a floppy disk, load the saved data, format a floppy disk and delete data.

Chapter10 Using Other Functions

Describes how to output measured data to a plotter, input/output the reference signal, output monitor signals, initialize the set-up information, calibrate the instrument, set the screen contrast and set the touch key sound.

Chapter11 Troubleshooting and Maintenance

Describes corrective actions to be taken in case of problems and their causes, describes error messages, how to use the error logging and self-test functions, adjust the time base, carry out the performance test and reset the circuit breaker.

Chapter12 Specifications

Describes the specifications of the instrument.

Index

Describes important terms.

Notations and Symbols Used in this Manual

Unit

k :1000 (e.g. 100 kHz)
K :1024 (e.g. 640 KB (floppy disk memory capacity))

Symbols Used

The following symbols are used in this User's Manual.

To avoid injury or death of personnel, or damage to the instrument, the operator must refer to the User's Manual. In the User's Manual, these symbols appear on the pages to which the operator must refer.

WARNING Describes precautions that should be observed to prevent the danger of serious injury or death to the user.

CAUTION Describes precautions that should be observed to prevent the danger of minor or moderate injury to the user, or the damage to the property.

Note Provides information that is important for proper operation of the instrument.

Symbols used on pages where description of operation is given

The following symbols are used in chapters 3 to 11, to classify descriptions.

Procedure Describes keys to be used and operating procedure. With some operating procedures, it is not necessary to carry out the steps according to the order in which they are described.

Explanation Gives a detailed description of settings and restrictions regarding operations. No detailed description is given for the function. For a detailed description of the function, refer to Chapter 1.

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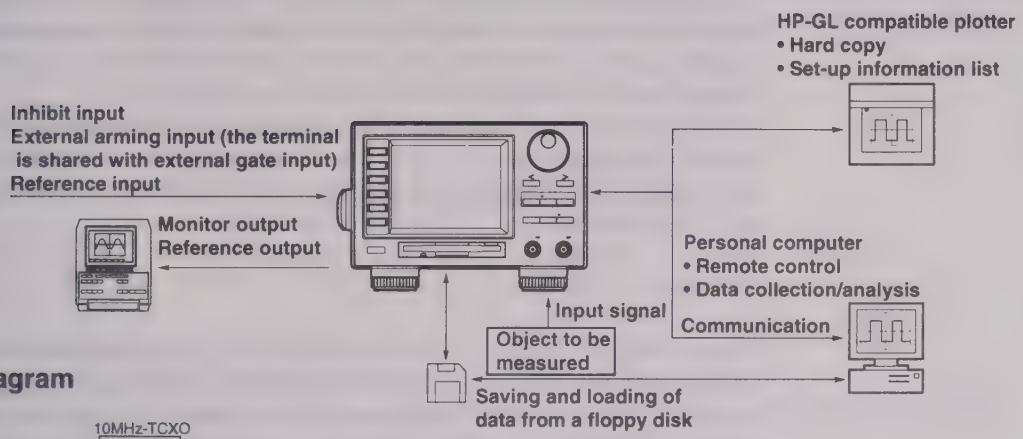
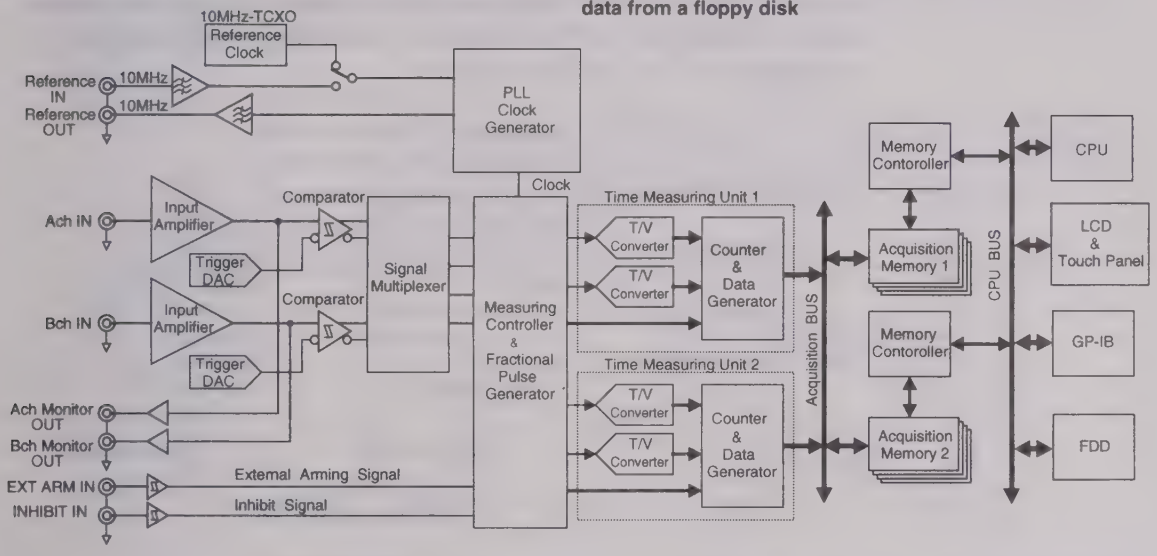
1.1 System Configuration and Block Diagram

System Configuration



Block Diagram



Signal Flow

The signal input to the input terminal (Ach IN, Bch IN) is converted into a low-impedance signal by the input amplifier. It is then sent to the comparator, where it is converted to a binary signal. At the same time, the signal from the input amplifier is output as a monitor signal via the output terminal (Ach Monitor OUT, Bch Monitor OUT).

The signal multiplexer selects the binary signal according to the selected measurement function (item), then the signal is input to the measuring controller. The measuring controller controls measurement and creates fractional pulse according to the external arming signal and inhibit signal. The width of the fractional pulse is measured, with a resolution of 100 ps, by the T/V converter of the time measuring unit (1, 2), and then compared with the value on the digital counter, to provide measured data. With continuous measurement, two time measuring units (1, 2) are activated alternately.

In time stamp mode (see the following page), both measured value and time stamp data (elapsed time) are acquired in each acquisition memory (1, 2). In hardware histogram mode (see the following page), the frequency of each measured value (i.e. number of the same measured values) is acquired in each acquisition memory. The acquired data is then sent via the memory controller to a CPU, where it is used for statistical computation or displayed on the LCD.

Either the signal from the internal crystal oscillator (compensated against temperature drift) or an external reference signal (input to the Reference IN terminal) can be used as the reference clock. In either case, the reference clock is output through the 10-MHz band pass filter to the Reference OUT terminal.

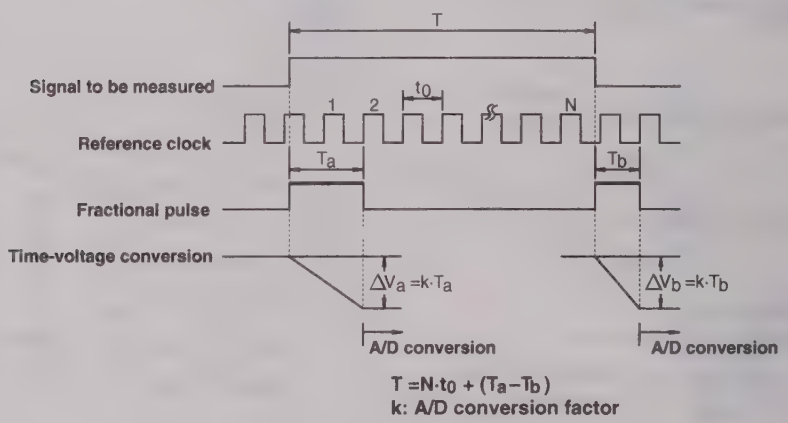
1.2 Measuring Principles and Sampling Mode

Measuring Principles

Time shorter than the period of the reference clock is called fractional time. In general, since the signal to be measured is not synchronized with the reference clock, fractional time exists at both beginning and end of measurement. This instrument generates a fractional pulse comprised of the fractional time and the time equivalent to one cycle of the reference clock.
With the pulse width of the signal to be measured, period of the reference clock and time span of each fractional pulse assumed to be T, t_0, Ta and Tb respectively, T can be separated into multiplication of the period of the reference clock ($N \cdot t_0$) and period of each fractional pulse (T_a and T_b) as shown below.

$$T = N \cdot t_0 + (T_a - T_b)$$

With this instrument, T_a and T_b, the time of fractional pulses generated at the beginning and end of measurement, are converted into a voltage value, which is then converted into a digital value by a 8-bit A/D converter. This enables measurement of the time of fractional pulse, with time resolution of 100 ps per 1 LSB. T is calculated by substituting the measured time of each fractional pulse for T_a and T_b of the above formula.



Sampling Mode

≡For operating procedure, refer to 5.1≡

Two sampling modes are available: time stamp mode and hardware histogram mode. The sampling method (acquisition method of measured data) and display format (display method) differ depending on the sampling mode. For a detailed description of display format, refer to 1.6, "Displaying the Measured/Computed Data".

Time stamp mode

Measured values and their time stamps (i.e. the time on which measurement is taken) are acquired into the acquisition memory, and used as time-series data. The maximum sample size (i.e. the maximum allowable number of data items to be acquired) is 32,000, though it varies depending on the measurement function (refer to section 1.3). The measured values can be displayed in four formats (histogram, list (measured values and time stamp), time variation and statistic values.

* Time stamp is expressed as the elapsed time between that when arming is activated (refer to section 1.5) and when measurement for one sample is completed.

Hardware histogram mode

The measured value and its occurrence frequency are acquired into the acquisition memory. The maximum sample size (i.e. the maximum allowable number of data items to be acquired) is 99,999,999. The measured values can be displayed in three formats (histogram, list (measured values and frequency) and statistic values.).

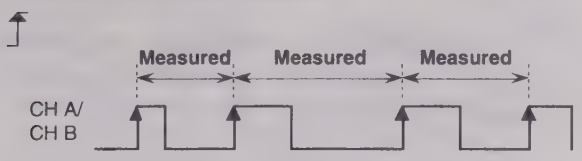
1.3 Measurement Functions (Measurement Items)

Period

≡For operating procedure, refer to 5.2≡

The time from a rising (or falling) edge to the next rising (or falling) edge of the input signal is measured. Either rising or falling edge can be selected, and channel A or B can be selected for measurement.

Example (rising slope is selected)



Time Interval

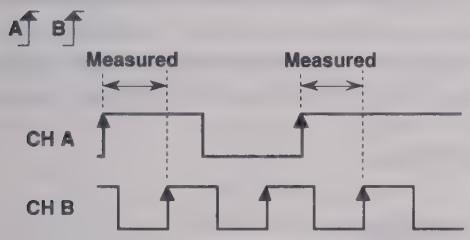
≡For operating procedure, refer to 5.3≡

The time interval between the signal input to channel A and that input to channel B is measured. The following two types of time interval can be measured.

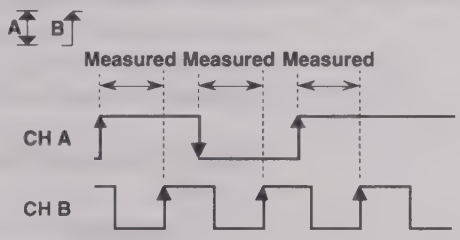
A-to-B interval

The time interval between an edge of the signal input to channel A and the first edge of the signal input to channel B is measured. Various combinations of edges can be selected as follows. For a description of combinations of slopes, refer to 5.3, "Setting Time Interval Measurement".

Example (Both channels A and B: rise)



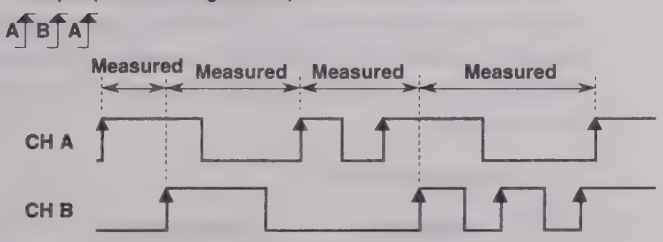
Example (Channel A: both rise and fall, channel B: rise)



A-to-B-to-A interval

The time interval between an edge of the signal input to channel A and the first edge of the signal input to channel B, and the time interval between an edge of the signal input to channel B and the subsequent edge of the signal input to channel A are measured. For a description of combinations of slopes, refer to 5.3, "Setting Time Interval Measurement".

Example (All three edges: rise)

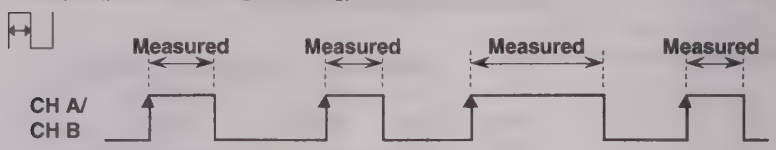


Pulse Width

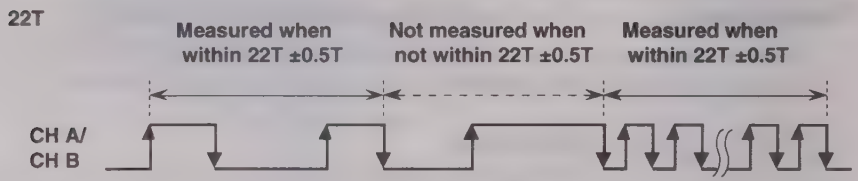
≡For operating procedure, refer to 5.4≡

The time between a rising (or falling) edge and the next falling (or rising) edge of the input signal is measured. For selection of combinations of polarity, refer to 5.4, "Setting Pulse Width Measurement". A special combination of polarity, in which a time constant T (see section 1.4) is specified to carry out measurement only when the period of the pulse is within the specified time range (22T±0.5T). This combination is called "22T". For measurement of pulse width, channel A or B can be selected.

Example (positive: rising to falling)



Example (22T)

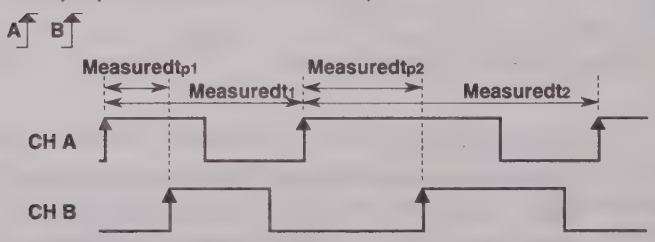


Phase Difference

≡For operating procedure, refer to 5.5≡

The time between an edge of the signal input to channel A and an edge of the signal input to channel B is measured, and the measured value is then expressed in phase difference (deg) in relation to the period of the signal input to channel A which is set as 360 degrees. This measurement is available only when time stamp mode is selected as the sampling mode. For a description of combinations of slopes, refer to 5.5, "Setting Phase Difference Measurement".

Example (Both channels A and B: rise)



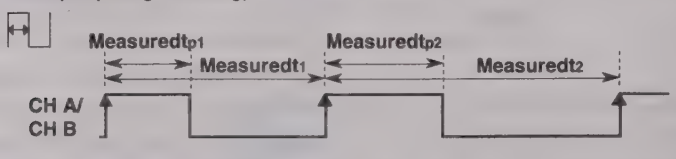
$$\text{Phase difference 1 [deg]} = \frac{t_{p1}}{t_1} \times 360 \qquad \text{Phase difference 2 [deg]} = \frac{t_{p2}}{t_2} \times 360$$

Duty Ratio

≡For operating procedure, refer to 5.6≡

The ratio of the time between a rising (or falling) edge and the next falling (or rising) edge in relation to one period of the input signal is measured. This measurement is available only when time stamp mode is selected as the sampling mode. For measurement of duty ratio, channel A or B can be selected.

Example (rising to falling)



$$\text{Duty ratio 1 [\%]} = \frac{t_{p1}}{t_1} \times 100 \qquad \text{Duty ratio 2 [\%]} = \frac{t_{p2}}{t_2} \times 100$$

1.4 Computation

Readout Function

≡For operating procedure, refer to 7.1 and 7.5≡

If histogram or time variation display format is selected (see 1.6), two markers (X1 and X2) will be displayed. This enables reading out of the coordinates of each cross-point of the markers and the histogram (or time variation). In addition, selecting a calculation area (see the following page) enables statistical computation for the area enclosed by the markers.

Histogram display format

The meaning of each value displayed at the bottom of the screen is given below.

X1: X-axis coordinate of X1 marker (measured value)

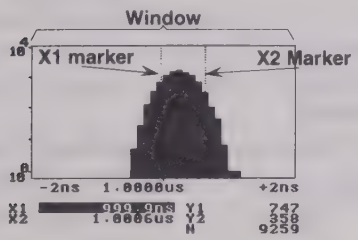
Y1: Y-axis coordinate of X1 marker (frequency of X1)

X2: X-axis coordinate of X2 marker (measured value)

Y2: Y-axis coordinate of X2 marker (frequency of X2)

N:

- WINDOW selected as calculation area: Total number of samples within the window
- MARKER selected as calculation area: Number of samples present within the area enclosed by X1 and X2 markers



Time variation display format

The meaning of each value displayed at the bottom of the screen is given below.

X1: X-axis coordinate of X1 marker (time stamp)

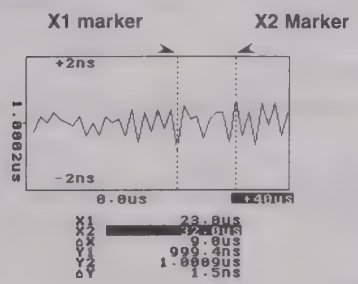
X2: X-axis coordinate of X2 marker (time stamp)

ΔX: X2 - X1

Y1: Y-axis coordinate of X1 marker (measured value)

Y2: Y-axis coordinate of X2 marker (measured value)

ΔY: |Y2 – Y1|



Calculation

≡For operating procedure, refer to 7.1 and 7.7≡

The following functions are available to select/set parameters required for statistical computation.

Selecting the calculation area

This function allows the user to select whether to carry out statistical computation using the measured values present in the entire window of a histogram or using those present within the area enclosed by the markers.

Setting the constant

This function allows the user to set the constant T to be used for calculation of jitter 1 (σ/T) or jitter 2 (|AVE - X_{center}| / T) or the one to be used for measurement of pulse width (22T).

Statistical Computation Items ≡For operating procedure, refer to 7.1 and 7.8≡

Statistical computation can be carried out using measured values. Computation results can be displayed if histogram or statistic display format is selected (see 1.6). The entire area of a histogram (i.e. entire window area) or the area enclosed by the X1 and X2 markers can be used as the calculation area. The formula may differ depending on the sampling mode.

Time stamp mode

In the following formulas, "n" indicates the number of samples and X_i indicates the measured value for each sample.

- **Maximum value (MAX)**

  Indicates the largest value among the measured values.

$$MAX = [X_i]_{max}$$

- **Minimum value (MIN)**

  Indicates the smallest value among the measured values.

$$MIN = [X_i]_{min}$$

- **Average value (AVE)**

  Calculates the average of the measured values.

$$AVE = \frac{1}{n}\sum_{i=1}^{n} X_i$$

- **Standard deviation (σ)**

  Calculates the standard deviation of the measured values. Standard deviation indicates degree of dispersion.

$$\sigma = \sqrt{\frac{1}{n}\sum_{i=1}^{n} (X_i - AVE)^2}$$

- **Peak to peak (P-P)**

  Calculates the difference between the maximum and minimum values.

$$P\text{-}P = MAX - MIN$$

- **Flutter (σ/AVE)**

  Calculates flutter. Flutter indicates degree of dispersion in percentage in relation to the average value.

$$\sigma / AVE = \frac{\sigma}{AVE} \times 100(\%)$$

Hardware histogram mode

In the following formulas, "n" indicates the number of bins of a histogram. "Bin" refers to each bar of the histogram and indicates frequency of the same measured data. X_i indicates the class value of each bin. The width of bins varies depending on the specified span of X-axis, and may be as small as 100 ps. In this case, X_i indicates the measured value. For details, refer to 1.6.

- **Maximum value (MAX)**

  Indicates the largest value among the class values.

$$MAX = [X_i]_{max}$$

- **Minimum value (MIN)**

  Indicates the smallest value among the class values.

$$MIN = [X_i]_{min}$$

- **Average value (AVE)**

  Calculates the average value of the histogram. P_i indicates relative frequency (*).

$$AVE = \sum_{i=1}^{n} X_i \times P_i$$

  * P_i can be calculated using the formula "$P_i = N_i / N$" when the total number of samples to be used for statistical computation is N and frequency (number of samples) of a bin is N_i.

- **Standard deviation (σ)**

  Calculates the standard deviation of the histogram. Standard deviation indicates degree of dispersion. P_i indicates relative frequency.

$$\sigma = \sqrt{\frac{1}{n} \sum_{i=1}^{n} (X_i - AVE)^2 \times P_i}$$

- **Peak to peak (P-P)**

  Calculates the difference between the maximum and minimum values.

$$P\text{-}P = MAX - MIN$$

- **Flutter (σ/AVE)**

  Calculates flutter of the histogram. Flutter indicates degree of dispersion in percentage in relation to the average value.

$$\sigma / AVE = \frac{\sigma}{AVE} \times 100(\%)$$

- **Jitter 1 (σ/T)**

  Constant T is used to calculate jitter 1 of the histogram. Jitter 1 indicates degree of dispersion in percentage in relation to constant T.

$$\sigma / T = \frac{\sigma}{T} \times 100(\%)$$

- **Jitter 2 (MELE, Maximum Effect Length Error)**

  Constant T is used to calculate jitter 2 of the histogram. X_{center} indicates the center value of X-axis in the window. For details, refer to 1.6. X_{center} means the value around which measured values are distributed. Jitter 2 indicates deviation of the average value from X_{center} in percentage in relation with constant T.

$$MELE = \frac{| AVE - X_{CENTER} |}{T} \times 100(\%)$$

1.5 Setting the Acquisition Conditions for Input Signal to be Measured

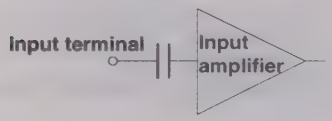
Input Coupling

≡For operating procedure, refer to 6.1≡

When you want to measure only (AC components) of the input signal or only the signal overlapping with the specified DC voltage, measurement can be facilitated if DC components are removed from the signal. In other cases, you may want to measure all the AC and DC components of the input signal. In these cases, an appropriate input coupling can be selected. The following input coupling methods are available.

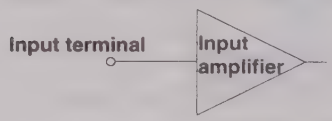
AC coupling

The signal is input to the amplifier through a capacitor. AC coupling is used to measure only the amplitude of the input signal by removing DC components or measure only the signal which overlaps the specified DC voltage.



DC coupling

The signal is input directly to the amplifier. DC coupling is used to measure all the AC and DC components of the input signal



Input Impedance

≡For operating procedure, refer to 6.1≡

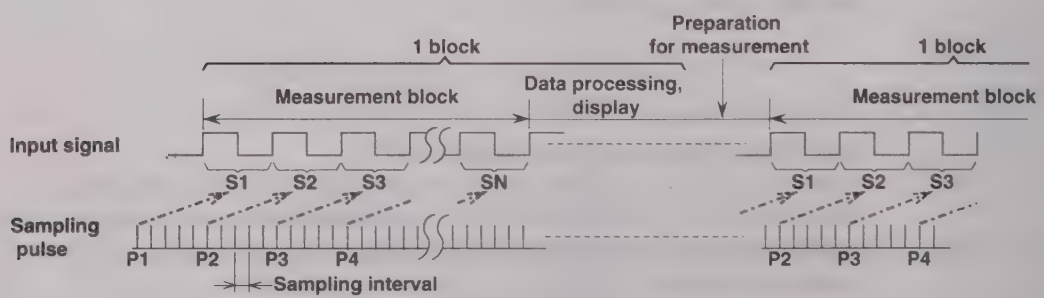
To reduce attenuation or distortion of the signal to be measured, an input impedance can be selected from 50 Ω and 1 MΩ to match the output impedance of the source of the signal.

Measurement Block

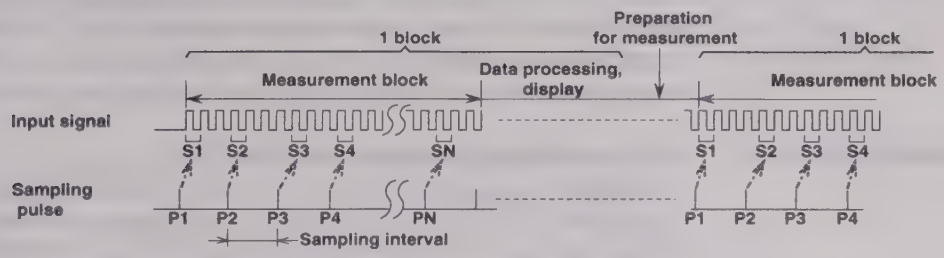
The instrument carries out a series of processes, from measurement to data processing and display, repeatedly. The minimum block of each series of processes is called "measurement block". When the number of samples (number of data items) for each series is assumed to be N, each series of processes (measurement, processing and display of N samples) is called "one-block measurement".

Samples S1, S2, S3 to SN within the measurement block are measured as shown below by sampling pulses P1, P2, P3 to PN generated at the specified sampling intervals. (For setting the sampling intervals, refer to page 1-10.)

When the period of the input signal is longer than the sampling interval



When the period of the input signal is shorter than the sampling interval



Trigger Mode/Trigger Level ≡For operating procedure, refer to 6.1≡

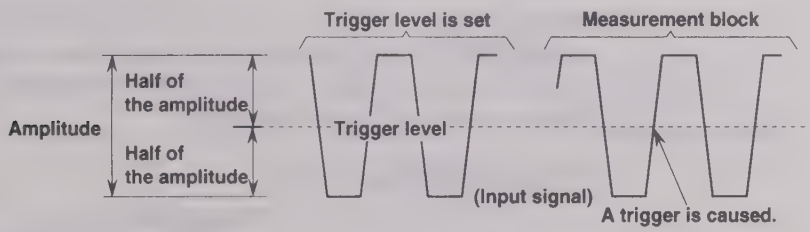
The instrument allows the user to specify the level at which measurement is to be carried out. This level is called trigger level.

Single auto trigger

The center level of the amplitude of the input signal is set as the trigger level automatically during the cycle just before the first measurement block. This trigger level will be used for all the subsequent measurement blocks.

Repeat auto trigger

The center level of the amplitude of the input signal is set as the trigger level automatically during the cycle just before each measurement block. Unlike the single auto trigger, the trigger level is set for each measurement block.



Manual trigger

The level set using the rotary knob or front panel keys is set as the trigger level.

Gate ≡For operating procedure, refer to 6.2≡

The instrument allows the user to specify the size of measurement block. Measurement can be carried out as many as the specified number of events or during the specified gating time (i.e. while the gate is open). Three types of gate are available.

Event gate

Each sampling is called an event. For instance, one measurement of the period of the input signal is counted as one event. Up to 32,000 events (16,000 events for duty ratio/phase difference measurement) can be set in the case of time stamp mode and up to 99,999,999 events can be set in the case of hardware histogram mode, within 320 seconds following the arming (see the following page).

Time gate

Gating time of up to 10 seconds can be set. However, the maximum number of events allowed for the sampling mode must not be exceeded.

External gate

The external arming input terminal (EXT ARM IN) is used to open/close the gate(See the following page). The gate can be opened for up to 320 seconds, as long as the maximum number of events allowed for the sampling mode is not exceeded. In addition, it is possible to select whether to open the gate using the positive or negative edge of the external arming signal.

Sample Size (Number of Events) ≡For operating procedure, refer to 6.2≡

The allowable number of measured data items to be acquired into the acquisition memory is called sample size. This setting is required if event gate is selected. Up to 32,000 events (16,000 events for duty ratio/phase difference measurement) can be set in the case of time stamp mode and up to 99,999,999 events can be set in the case of hardware histogram mode.

Sampling Interval ≡For operating procedure, refer to 6.2≡

The sampling interval is the interval at which a sample is acquired. A sampling pulse (see "Measurement Block") is generated at sampling intervals, and measurement is carried out when the input signal satisfies the trigger conditions (trigger level, slope etc.) after the sampling pulse. The sampling interval can be set between approximately 71 ns (reciprocal of the maximum sampling rate 14 MS/s) and 4 ms in the case of time stamp mode. For hardware histogram mode, the sampling interval is fixed at approximately 71 ns.

Arming ≡For operating procedure, refer to 6.3≡

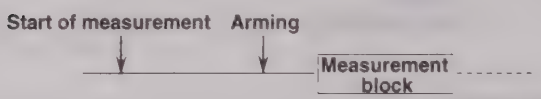
Measurement of a measurement block is started when arming is activated. Two arming methods are available: auto arming in which measurement starts immediately when the START key is pressed or START communication command is issued, and external arming in which measurement starts when the external arming signal is input.

Auto arming

Arming is activated automatically after the START key is pressed or START communication command is issued. For auto arming, the internal arming signal is used.

External arming

Arming is activated when the external arming signal is input to the EXT ARM IN terminal following start of measurement. It is possible to select whether to activate arming using the rising or falling edge of the external arming signal.



Arming Delay ≡For operating procedure, refer to 6.3≡

With the external arming method, it is possible to delay measurement until a certain time elapses or the specified number of events occur following activation of arming. The following two arming delay methods are available.

Time delay

Measurement starts after the specified time (up to 1 second) has elapsed.

Event delay

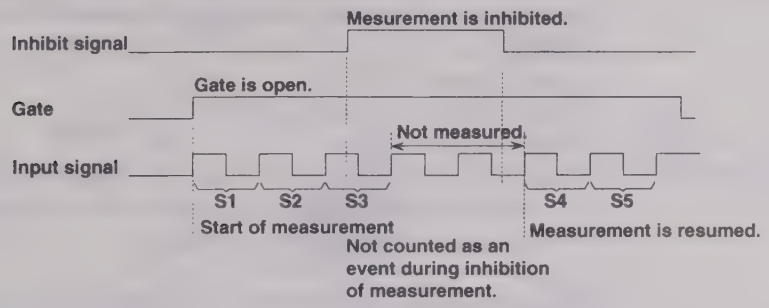
Measurement starts after the specified number of events (up to 30,000) have occurred.

Inhibit

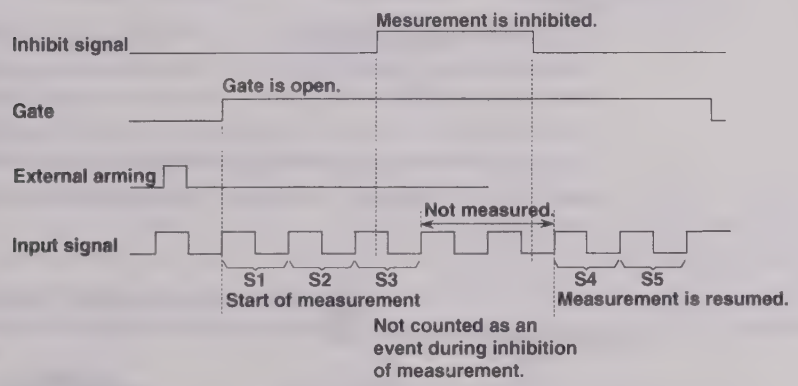
≡For operating procedure, refer to 6.4≡

Measurement can be inhibited by inputting the inhibit signal to the INHIBIT IN terminal. This is also possible while the gate is open or during measurement following the arming delay. Measurement can be inhibited for up to 320 seconds. In addition, it is possible to select whether to inhibit measurement using the positive or negative edge of the inhibit signal.

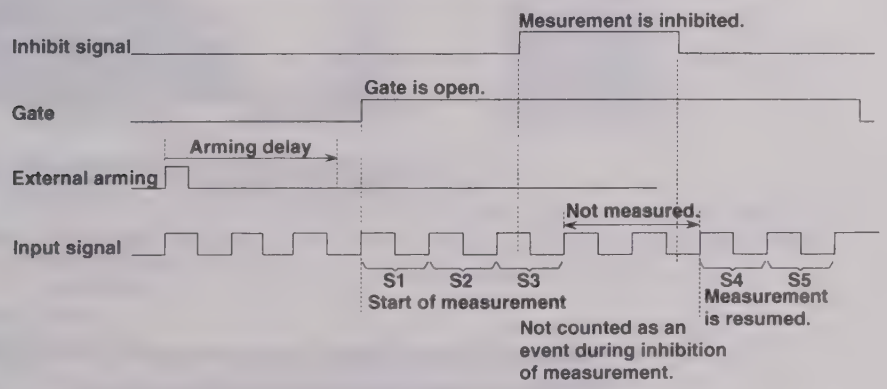
Relation between the inhibit signal and gating



Relation between the inhibit signal and gating/external arming



Relation between the inhibit signal and gating/external arming/arming delay



1.6 Displaying the Measured/Computed Data

Histogram Display

≡For operating procedure, refer to 7.1≡

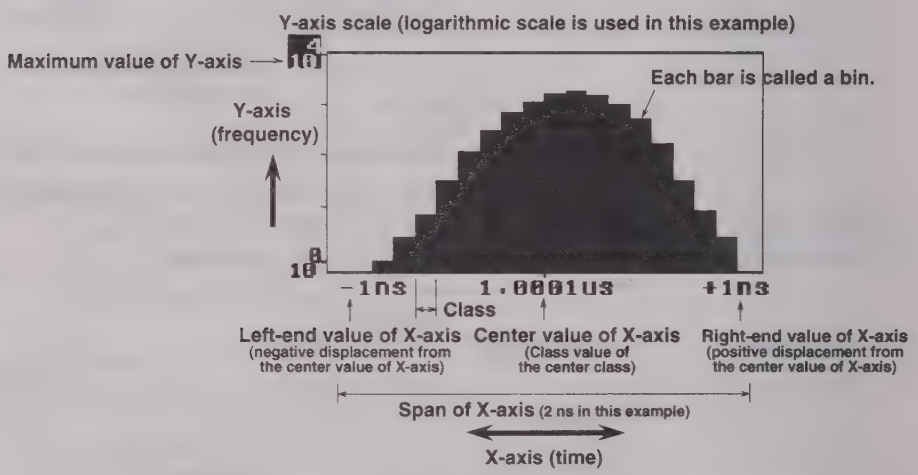
A histogram of measured data is displayed for each measurement block to allow the user to observe data distribution. Although period, phase difference or duty ratio can be set for the X-axis and frequency for the Y-axis manually, they can be set automatically using the auto scaling function. The following items can be set manually.

- Center value of X-axis
- Span of X-axis
- Y-axis scale (linear or logarithmic scale)
- Maximum value of Y-axis
- Space between the center values of X-axis (This setting is required when you are using the multi-window function in hardware histogram mode.) For a description of the multi-window function, refer to "Multi-window" on this page.

Histogram displayed when time stamp mode is selected or when hardware histogram mode is selected and only one window is used (i.e. multi-window function is OFF)

A histogram is displayed according to the settings made for the above items.

If a class has a time span, for instance, if the minimum and maximum values in the class are 505 ns and 515 ns, respectively, 510 ns will be treated as the class value, and samples in this class are all considered as 510 ns. If the measured values in this class are all the same, they will be treated as the class value. Each value given along the X-axis as shown below indicates either the class value or displacement. A histogram is created as the number of samples in each class are accumulated.


Y-axis scale (logarithmic scale is used in this example)
Maximum value of Y-axis
Each bar is called a bin.
Y-axis
(frequency)
−1ns
1.0001us
+1ns
Class
Left-end value of X-axis
(negative displacement from the center value of X-axis)
Center value of X-axis
(Class value of the center class)
Right-end value of X-axis
(positive displacement from the center value of X-axis)
Span of X-axis (2 ns in this example)
X-axis (time)

Histogram displayed when hardware histogram mode is selected and more than two windows are used (i.e. multi-window function is ON)

Refer to "Multi-window" and "Panorama Display" given in this section.

Multi-window

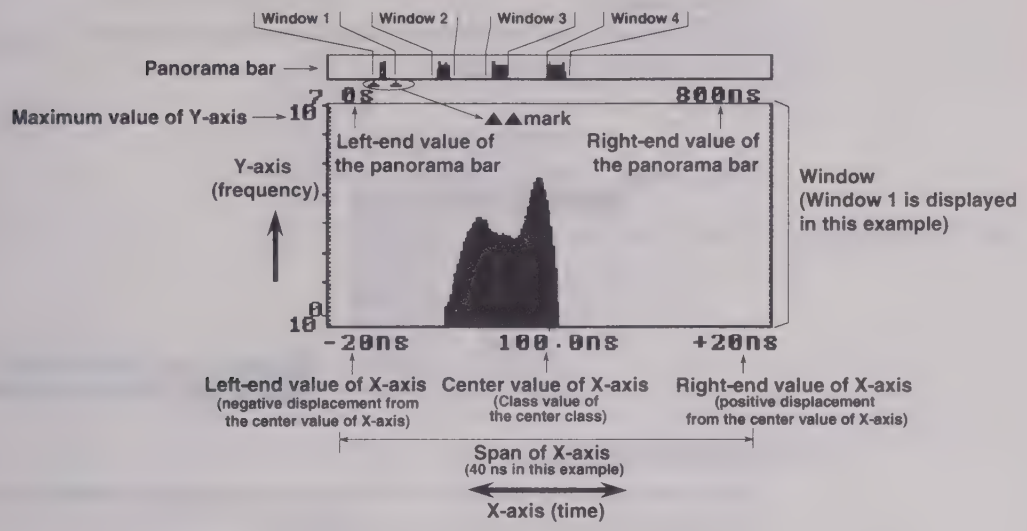
≡For operating procedure, refer to 7.2≡

If data for a measurement block is distributed along more than two center values of X-axis, more than two histograms will be created. Although all the histograms can be displayed within one window, it is possible to set more than two windows to allow each histogram to be displayed in its own window. This function is called the multi-window function. Up to 16 windows can be set. An example of a window is shown in "Panorama Display" on the following page.

Using the multi-window function in conjunction with the panorama display function enables the user to recognize easily which histogram is currently displayed.

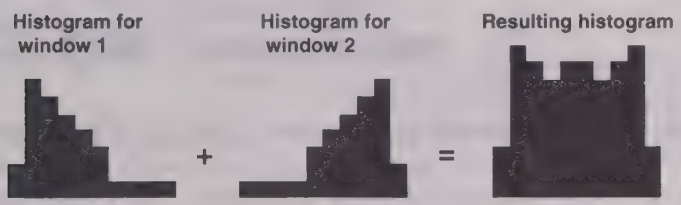
Panorama Display ≡For operating procedure, refer to 7.3≡

A panorama bar is displayed at the top of the screen during hardware histogram mode. The panorama bar shows all the histograms of measured data. The histogram currently displayed in the window is enclosed by " ▲▲ marks," so that the user can easily understand which histogram is currently displayed.


Window 1
Window 2
Window 3
Window 4
Panorama bar
0s
800ns
Maximum value of Y-axis
▲▲mark
Left-end value of the panorama bar
Right-end value of the panorama bar
Y-axis (frequency)
Window (Window 1 is displayed in this example)
-20ns
100.0ns
+20ns
Left-end value of X-axis (negative displacement from the center value of X-axis)
Center value of X-axis (Class value of the center class)
Right-end value of X-axis (positive displacement from the center value of X-axis)
Span of X-axis (40 ns in this example)
X-axis (time)

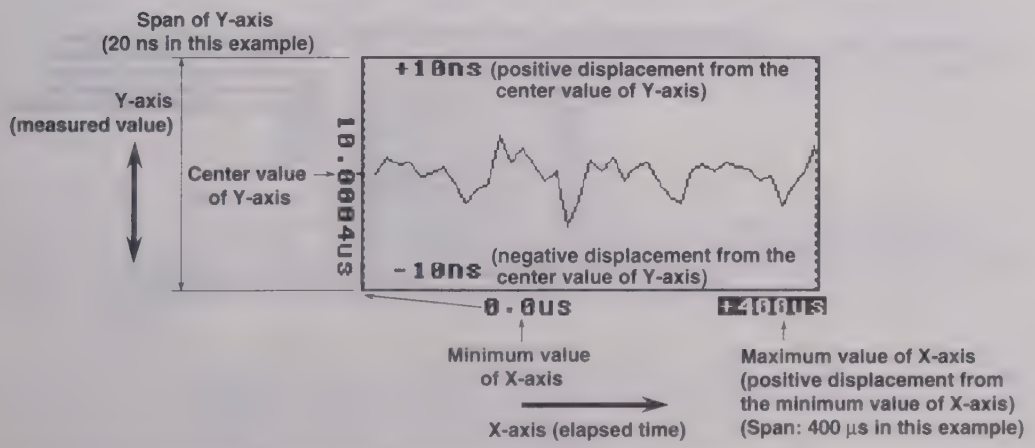
Histogram Data Addition ≡For operating procedure, refer to 7.4≡

It is possible to add the histogram of each window specified using the SIZE touch key during multi-window setting, and display the resulting histogram in a single window. The frequency of the bin located at the center value of X-axis of each histogram is added, and then the frequency of each bin located on the left and right of that bin is similarly added. This enables comparison of data distribution between histograms and global statistical computation of all the histograms.



Time Variation Display ≡For operating procedure, refer to 7.5≡

During time stamp mode, measured values and time stamps are treated as data and acquired in the acquisition memory. The time variation display function uses this time-series data to display variation of measured values in relation to the elapsed time following the arming.


Span of Y-axis (20 ns in this example)
Y-axis (measured value)
+10ns (positive displacement from the center value of Y-axis)
Center value of Y-axis
10.0004us
-10ns (negative displacement from the center value of Y-axis)
0.0us
Minimum value of X-axis
Maximum value of X-axis (positive displacement from the minimum value of X-axis) (Span: 400 μs in this example)
X-axis (elapsed time)

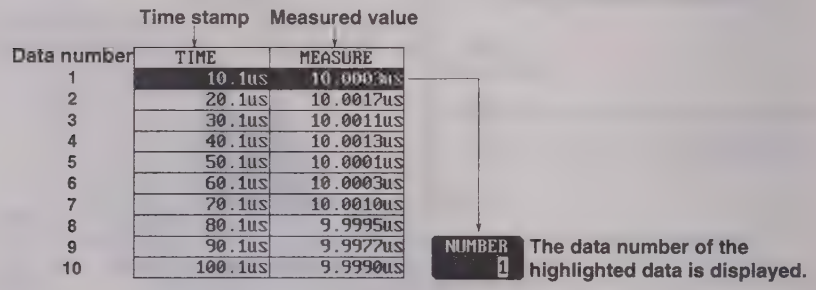
List Display

≡For operating procedure, refer to 7.6≡

A list of measured values is displayed. This function enables the user to jump to the top or bottom data in the list, and set data numbers to locate/display the measured value of the desired data number. The contents of the list vary according to the selected sampling mode.

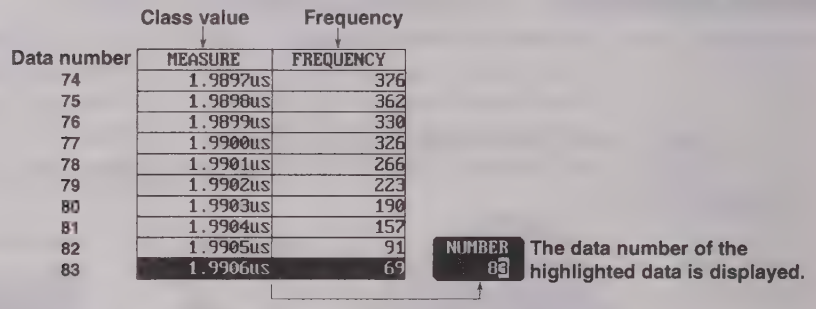
Time stamp mode

A list of time stamps and their measured values for the number of events/time range specified in gating setting (see 1.5) is displayed.



Hardware histogram mode

A list of measured values (class values of histogram) and their frequency within the span of X-axis specified in histogram display setting is displayed.



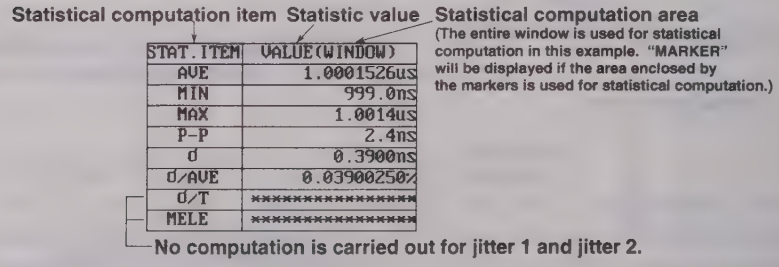
Statistics Display

≡For operating procedure, refer to 7.7 and 7.8≡

A list of statistic values is displayed. For statistical computation items, computation and computation area, refer to 1.4, "Computation". The contents of the list vary according to the selected sampling mode.

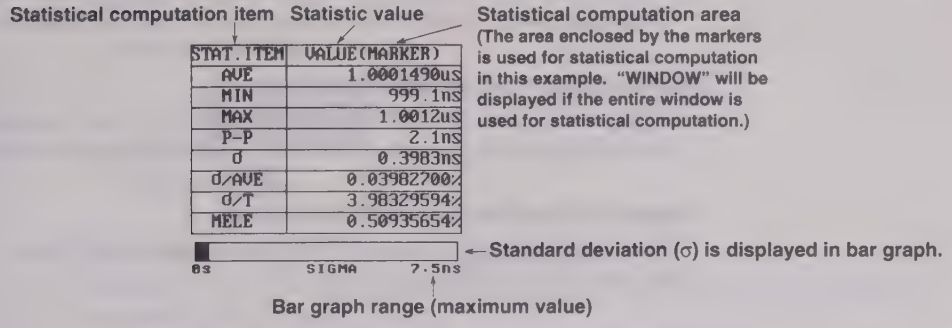
Time stamp mode

No computation is carried out for jitter 1 (σ/T) and jitter 2 (MELE), so no results are displayed.


Statistical computation item
Statistic value
Statistical computation area
(The entire window is used for statistical computation in this example. "MARKER" will be displayed if the area enclosed by the markers is used for statistical computation.)
STAT.ITEM
VALUE(WINDOW)
AVE 1.0001526us
MIN 999.0ns
MAX 1.0014us
P-P 2.4ns
σ 0.3900ns
σ/AVE 0.03900250%
σ/T ********
MELE ********
No computation is carried out for jitter 1 and jitter 2.

Hardware histogram mode

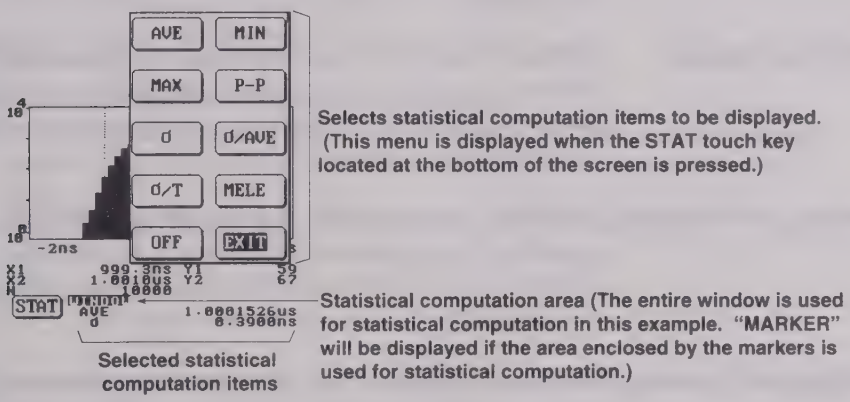
A bar graph indicating the standard deviation (σ) is displayed below the list. The bar graph range (maximum value) can be selected (see below).



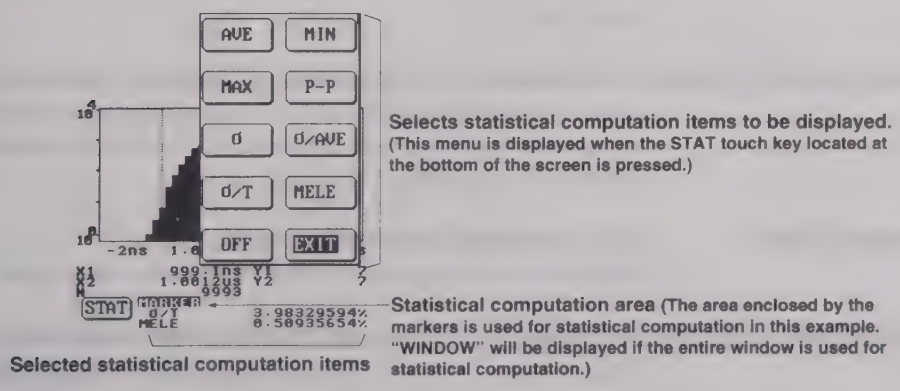
Statistics values during histogram display

The statistical computation area and items (two items) are displayed while a histogram is displayed. It is possible to select statistical computation items to be displayed.

- **Time stamp mode**



- **Hardware histogram mode**



* "Touch key" is a key displayed on the LCD. Touching it with your finger will execute a certain operation.

1.7 Other Functions

External Signal Input/Output (Rear Panel) ≡For operating procedure, refer to 10.2 and 10.3≡

The following input and output terminals (BNC) are provided on the rear panel, to communicate with external devices. For location of each terminal, refer to 2.2, "Rear Panel".

Reference input terminal (REFERENCE IN)

Although the instrument has an internal reference clock to be used for measurements, it is possible to input an external signal (10 MHz) to this terminal and use it as the reference clock.

Reference output terminal (REFERENCE OUT)

The internal reference clock or external reference clock can be sent through a 10-MHz band pass filter and then output from this terminal.

Monitor output terminals (MONITOR OUT CHA, CHB)

Signals input to the input terminals can be output directly from these terminals. They can be used for observation of a waveform during phase correction of a probe.

External arming input/inhibit input terminals (EXT ARM IN, INHIBIT IN)

These signals are used to control measurement functions of the instrument. For the function of external arming or inhibit signal, refer to 1.5, "Setting the Acquisition Conditions for Input Signal to be Measured".

Communications ≡Refer to the GP-IB Interface User's Manual (IM704210-12E)≡

The instrument is equipped with a GP-IB interface as a standard feature. Use of this interface enables transmission of measured data to a personal computer to analyze it, and enables control of this instrument using an external controller.

Storing and Recalling of Set-up Information ≡For operating procedure, refer to Chapter 8≡

Up to 10 sets of set-up information can be stored in the internal non-volatile memory. It is also possible to recall the stored set-up information to set up the instrument. This function is useful when you want to use the set-up information repeatedly.

Saving and Loading Data from a Floppy Disk ≡For operating procedure, refer to Chapter 9≡

The instrument is equipped with a floppy disk drive. This enables the user to save set-up information and measured data to a floppy disk or load from it, whenever it is required. In addition, it is also possible to save the screen image data in TIFF format. This enables the user to import the saved screen image data to a document created by a DTP software application, to create a report.

Auto Loading of Set-up Information ≡For operating procedure, refer to 9.3≡

Turning ON the power after a floppy disk containing the set-up information is inserted into the floppy disk drive will load the set-up information to the instrument automatically. This is useful to restore the set-up information in the instrument.

Plotter Output ≡For operating procedure, refer to 10.1≡

Measured data can be output to an external plotter via the GP-IB interface.

Initialization of Set-up Information ≡For operating procedure, refer to 10.4≡

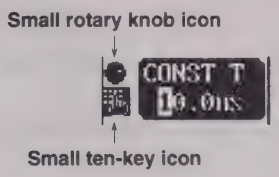
The set-up information can be reset to the factory settings (default settings).

Calibration ≡For operating procedure, refer to 10.5≡

Calibration of the offset voltage of each input amplifier and conversion factor of each T/V converter can be carried out using the internal calibration signal.

Numeric Value Setting ≡For operating procedure, refer to 4.2≡

A numerical value can be entered using the ten-key (displayed when the KEYBOARD key is pressed) while a small ten-key icon is displayed on the left of the currently highlighted touch key. This is useful when you need to set a value consisting of several digits. If a small icon is displayed, a numerical value can be entered using the rotary knob.



Contrast ≡For operating procedure, refer to 10.6≡

The contrast of the LCD display can be adjusted. Adjust it so that it suits the environment in which the instrument is used.

Touch-key Sound ≡For operating procedure, refer to 10.7≡

A beeping sound is heard when a touch key is pressed (touched) or an error occurs. It is possible to disable this beep.

Error Logging ≡For operating procedure, refer to 11.3≡

" ❗ " mark appears in the upper right corner of the screen if a data error such as overflow of measured data occurs or a communication error occurs. Error messages are recorded in the error logging window, to enable the user to observe them later.

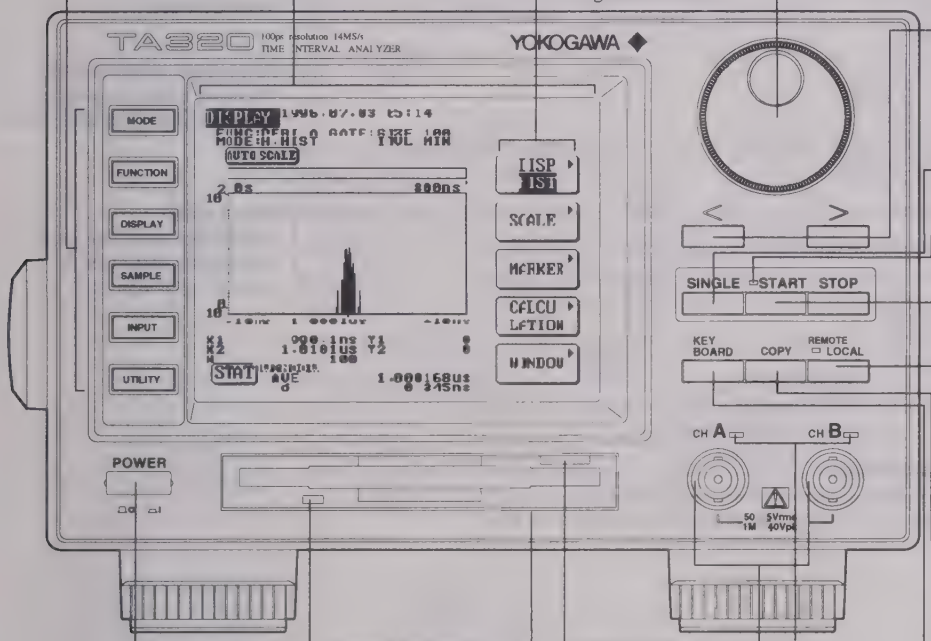
Self-test ≡For operating procedure, refer to 11.4≡

In case of a problem, a self-test can be carried out to enable the user to check the problem before contacting YOKOGAWA. This function enables inspection of the memory, PC board and display.

2.1 Front Panel

Top menu keys
Displays the corresponding top menu.

- **MODE key**
  Displays the sampling mode selection screen. (See 5.1.)
- **FUNCTION key**
  Displays menus for setting/selecting the measurement function, input channel and slope. (See chapter 5.)
- **DISPLAY key**
  Displays menus for setting/selecting the display format, window axis, markers, calculation. (See chapter 7.)
- **SAMPLE key**
  Displays menus for setting/selecting the gate, sample size, sampling interval, arming and inhibit. (See chapters 6.2, 6.3 and 6.4.)
- **INPUT key**
  Displays menus for setting/selecting the input coupling, input impedance, trigger mode and trigger level. (See chapter 6.1.)
- **UTILITY key**
  Displays menus for setting/selecting initialization of set-up information, storing and recalling of data in the internal memory, configuration (communication, contrast, date/time, touch key sound), self-test, saving and loading of data from a floppy disk, reference clock, calibration and initialization of a floppy disk. Also displays the error logging window and version No. (ROM version). (See 3.7, chapters 8,9, and 10, and 11.3 to 11.5.)



LCD display
(Touch screen)

Touch key
Press the area enclosed by ☐ to make various settings and selections.

Rotary knob
Sets a numerical value, moves markers and selects a file. (See 4.2, chapters 7 and 9.)

Arrow keys
Moves from one digit to another digit during setting of a numerical value. Also used as a back space key (<). (See 4.2.)

SINGLE key
Carries out measurement only once. (See 4.1.)

Measurement indicator
Lights up during acquisition of measured data.

START/STOP key
Starts/stops continuous measurement. (See 4.1.)

LOCAL key
Cancels remote control (REMOTE indicator lights up during remote control mode). Refer to the GP-IB Interface User's Manual (IM704210-12E).

COPY key
Saves the screen image data to a floppy disk/outputs the screen image data to an external plotter. (See 9.6 and 10.1.)

KEYBOARD key
Displays a ten-key (only when a ten-key icon is displayed on the left of a touch key).(See 4.2.)

Power switch
(See 3.4.)

Access indicator
Blinks while the floppy disk drive is in use.

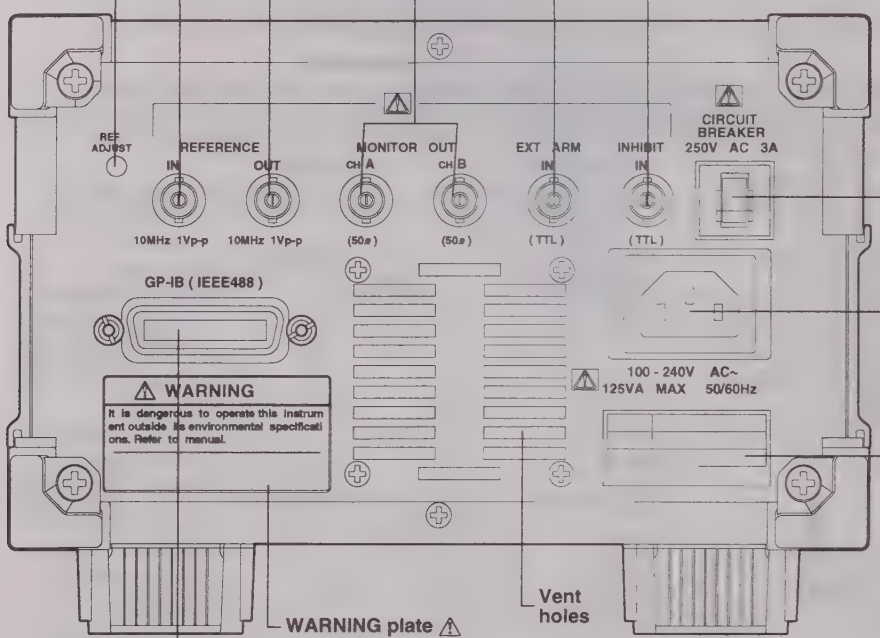
Eject button
Used to remove the floppy disk.(See 9.1.)

Floppy disk drive

CHA/CHB input indicator
Blinks while the signal is input and a trigger is caused.

CHA/CHB input terminal ⚠
Connect the input signal cables to these terminals. (See 3.5.)

2.2 Rear Panel



Adjustment hole for reference clock frequency
Used to adjust the time base. (See 11.5.)

Reference input terminal ⚠
The external reference clock is input to this terminal. (See 10.2.)

Reference output terminal ⚠
The reference clock is output from this terminal. (See 10.2.)

CHA/CHB monitor output terminal ⚠
Input signals are output from these terminals. (See 10.3.)

External arming input terminal (shared with the external gating input) ⚠
(See 6.2 and 6.3.)

Inhibit input terminal ⚠
(See 6.4.)

Circuit breaker ⚠
(See 11.7 for the resetting method.)

Power cord connector ⚠
The power cord is connected to this connector. (See 3.3.)

Name plate
Refer to this name plate when checking the contents of the package. (See page 2.)

Vent holes

WARNING plate ⚠
Safety Precautions. (See page 4.)
Usage Precautions. (See 3.1.)

GP-IB connector
Used to connect the instrument to an external device (e.g. personal computer). Refer to the GP-IB Interface User's Manual (IM704210-12E).

3.1 Usage Precautions

Safety precautions

- Be sure to read through the safety precautions given on page 4 of this manual before starting to use the instrument.
- Never remove the instrument's casing. The unit contains extremely hazardous high-voltage components. Consult your nearest Yokogawa representative (see listing on rear cover) if the instrument requires maintenance or adjustment.
- If the instrument emits smoke or unusual odors, or in any way behaves abnormally immediately turn OFF the power switch and unplug the power cord from the outlet. Then consult your nearest Yokogawa representative for assistance.
- If the cooling fan stops during operation, the instrument will display the error message shown below. When you see this message, turn OFF the power immediately. The fan (on the rear panel) may be jammed; check for and remove any obstructions, then restart. If the same error recurs, turn OFF the power and contact your nearest Yokogawa representative.

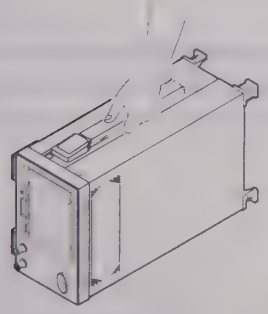
```
ERROR

906:  Fan stopped.
      Turn OFF the power immediately.
```

- Never rest any objects on the power cord. Keep the cord clear of hot objects at all times. When unplugging the power cord, pull on the plug area - never pull on the cord itself. If the cord is damaged, contact your dealer and obtain a replacement. (Quote the part number indicated on page 2 of this manual.)

Handling Precautions

- Never place liquid-filled containers or other potentially damaging objects on top of the instrument.
- Avoid subjecting the instrument to vibration and strong impacts, as these can cause hardware damage. Be especially careful if the instrument is equipped with a floppy disk drive. Also note that any impact to terminals or connecting cables may cause electrical noise to the output signal.
- Always keep terminals clear of electrically charged objects. Electrostatic at the terminals may cause internal damage.
- If you do not plan to use the instrument for an extended period, unplug the power cord.
- If you need to lift and move the instrument, first disconnect the power cord and connecting cables. Lift and carry by the handle, as shown. The instrument weighs approximately 5kg.

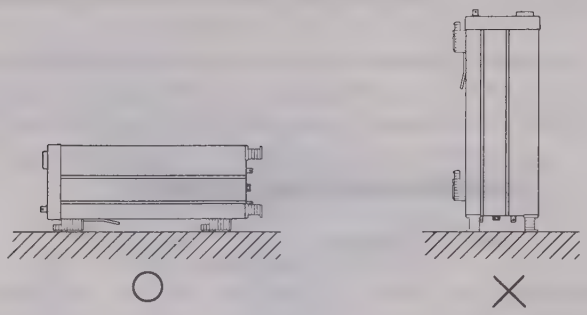


- Never touch the LCD (touch screen) with pointed objects. Contact with sharp objects may cause damage.
- Never clean plastic parts with benzene or other such solvents, as these may cause discoloration. To clean the case or panel, wipe lightly with a soft dry cloth.

3.2 Installing the Instrument

WARNING

You should never run the instrument in an upright position, with the fan vent facing downward. If the instrument malfunctions while in this position, heat escaping from the vent may cause a fire. If you really need to operate the instrument in this position, place a metal plate or flame-retardant barrier (grade UL94-1 or higher) beneath it.



Installation Conditions

Be sure to install the instrument in a location that meets the environmental conditions described below.

Ambient temperature and humidity

Ambient temperature and humidity during operation should be within the following limits.

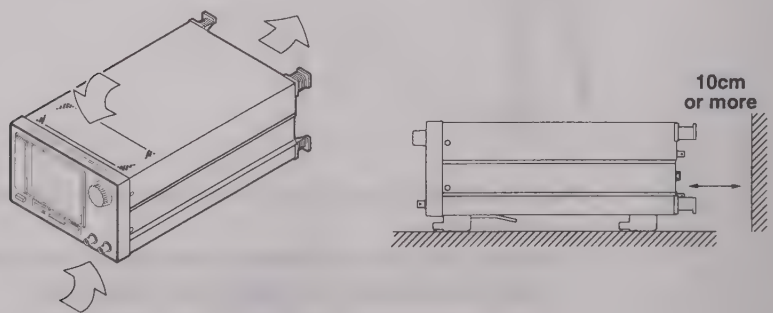
- Temperature: 5°C to 40°C
  For high accurate measurement: 23±2°C
- Humidity: 20% to 80% RH; no condensation
  For high accurate measurement: 50±10% RH

Note

Condensation may occur when the instrument is moved from a cold, dry location to a warm, humid one or when there is a rapid change in ambient temperature. If liquid condenses on the instrument, allow the instrument to stand for at least one hour under stable ambient conditions before using.

Well-ventilated location

Vent holes are situated on the top and bottom of the instrument. In addition, vent holes for the cooling fans are also situated in the rear panel. To prevent a rise in the internal temperature, the vent holes should not be blocked and sufficient clearance should be maintained around them.

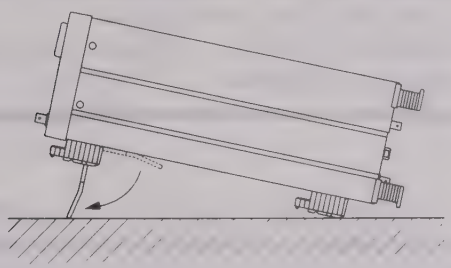


Install the instrument in a location that is:

- Away from direct sunlight and other heat sources.
- Away from oily smoke, steam, dust, corrosive gas, and other such contaminants.
- Away from strong magnetic fields.
- Away from high-voltage equipment and power lines.
- Away from mechanical vibrations.
- Stable surface.

Installation Position

Place the instrument in a horizontal position or tilted using the stand, as shown below. To install in the tilted position, pull the instrument's stand forward until it locks into place at right angles with the bottom panel. If the surface is slippery, you should also attach rubber feet (standard accessory) to the instrument's rear legs. To retract the stand, push it inwards at both ends while moving it back to its original position.



Rack Mounting

It is possible to mount the instrument on an optional rack.
For mounting instructions, refer to the user's manual supplied with the kit.
The following rack mount kits are available.

Name	Model	Specification
Rack Mount Kit	751533-E3	EIA Single Mount
Rack Mount Kit	751534-E3	EIA Dual Mount
Rack Mount Kit	751533-J3	JIS Single Mount
Rack Mount Kit	751534-J3	JIS Dual Mount

3.3 Connecting the Power Cord

Before Connecting the Power

Make sure that you observe the following points before connecting the power. Failure to do so may cause electric shock or damage to the instrument.

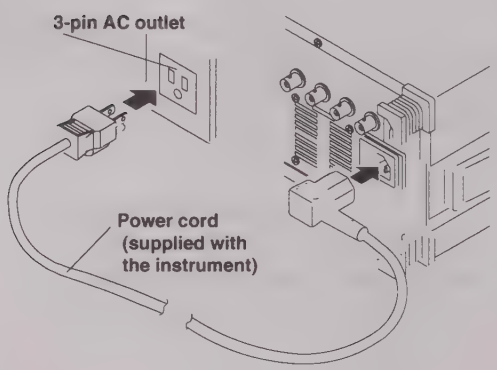
WARNING

- Make certain that the power voltage of your outlet matches the instrument's rated power voltage.
- Be sure that the instrument's power switch is OFF.
- Be sure that your power cord has been supplied by Yokogawa specifically for use with this instrument. Use of an inappropriate cord may present a shock or fire hazard.
- Always use protective ground to prevent electric shock. Connect the instrument's power cord to a 3-pin AC outlet with grounding terminal.
- Never use an extension cord that does not have a protective grounding, otherwise the protection feature will be invalidated.

Connecting the Power Cord

1. Make sure that the POWER switch located on the front panel is turned OFF.
2. Plug the power cord into the power connector socket on the rear panel of the instrument.
3. Plug the other end of the power cord into a 3-pin AC outlet that meets the following conditions.

   Rated supply voltage: 100 to 240 VAC
   Permitted voltage range: 90 to 264 VAC
   Rated power frequency: 50/60 Hz
   Permitted power frequency range: 48 to 63 Hz
   Maximum power consumption: 125 VA



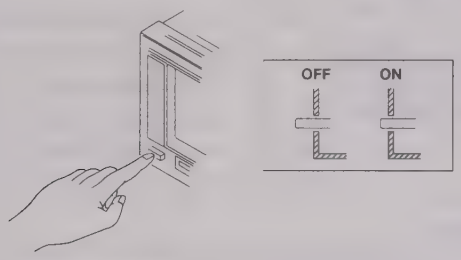
3.4 Turning the Power Switch ON/OFF

Items to be Checked Before Turning ON the Power

- Check that the instrument is installed correctly as instructed in 3.2 "Installing the Instrument".
- Check that the power cord is connected correctly as shown in 3.3 "Connecting the Power Cord".

Location of the Power Switch and Turning it ON/OFF.

The power switch is located at the lower left of the front panel. To turn the power ON, press the switch once. To turn the power OFF, press it again.



Power-ON Initialization

When the power is turned ON, the instrument executes the following initialization checks. Panel keys remain disabled during these checks. When initialization is completed, the display format screen (the screen which is displayed when the DISPLAY key is pressed) will be displayed.

- ROM Check: Checks the ROM.
- DRAM Check: Checks the DRAM.
- Backup Check: Checks the calibration data.

Note

If the instrument fails to start up as described, turn the power switch OFF and then check the following points.

- Check whether the power cord is plugged in properly.
- Check whether the correct voltage is being supplied from the AC outlet. (Refer to 3.3)
- Check whether the circuit breaker is ON. (Refer to 11.7.)

If the above checks do not resolve the problem, contact your nearest YOKOGAWA representative listed on the rear cover of this manual.

For Accurate Measurement

Turn the power switches ON and allow the unit to warm up for at least 30 minutes. Make sure that the installation conditions given in 3.2 are met.

Power-OFF Operation

The set-up information made prior to turning OFF the power will be retained even if the power is turned OFF. However, measured data will not be retained, so make sure that necessary data is saved to a floppy disk before turning the power OFF.

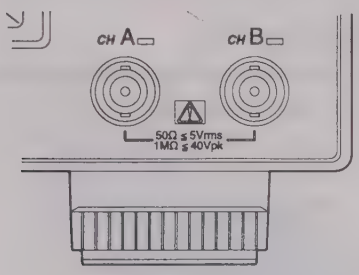
Note

The set-up information is backed up by a lithium battery. The battery lasts for approximately 10 years if it is used at an ambient temperature of 23°C. When the battery approaches the end of its life, the instrument begins to display incorrect dates or times, or may fail to save or recall measured data correctly. If any such problem is noticed, execute a self-test as described in 11.4, "Executing the Self-test". If "LOW BATTERY" warning message is displayed during the self-test, the battery needs to be replaced immediately. The battery cannot be replaced by the user, so contact the nearest YOKOGAWA representative listed on the rear cover of this manual.

3.5 Connecting the Cables/Probes

Location of Input Terminals

The input terminals are located at the lower right of the front panel. Use cables with a BNC connector or use probes.



Input Specifications

Connector type : BNC
Number of channels : 2
Input impedance : 50 Ω/1 MΩ, 20 pF (Typical *)
Maximum input voltage:

- When input impedance is 50 Ω : 5 V_{rms}
- When input impedance is 1 MΩ:
  - 40 V ($DC+AC_{peak}$) when DC ≦ input frequency ≦ 100 kHz
  - {3.5/f + 5}V ($DC + AC_{peak}$) when 100 kHz ≦ input frequency ≦ 100 MHz, " f " indicates frequency in MHz.

Ground: Connected to the case's ground.

* Typical values are described in terms of typical of average performance. However, they cannot be guaranteed.

CAUTION

Never apply a voltage exceeding the maximum input voltage to the input terminals. Damage to the input terminals may result.

Note

When you use a probe with this instrument for the first time, its phase must be corrected before use as described in 3.6, "Compensating a Probe (Carrying Out Phase Correction)". If the phase is not corrected, the gain will not be constant across different frequencies. Phase correction must be carried out for each channel.

3.6 Compensating a Probe (Carrying Out Phase Correction)

Items Required

The following items are required.

Calibration signal

- Frequency: 1 kHz
- Voltage: 1 V_{p-p}
- Waveform type: Square waveform
- Output impedance: 1 MΩ
- Recommended signal: CAL signal of the DL1540 digital oscilloscope (by YOKOGAWA)

Waveform monitor

- Frequency characteristic: DC to 100 MHz (attenuation point: -3 dB)
- Input coupling: DC
- Input impedance: Connect a 50 Ω terminator to the input terminal of the waveform monitor.
- Recommended monitor: DL1540 digital oscilloscope (by YOKOGAWA) + 50 Ω terminator (type: 700976, by YOKOGAWA)

The connecting and operating procedure for the recommended calibration signal and waveform monitor is described below.

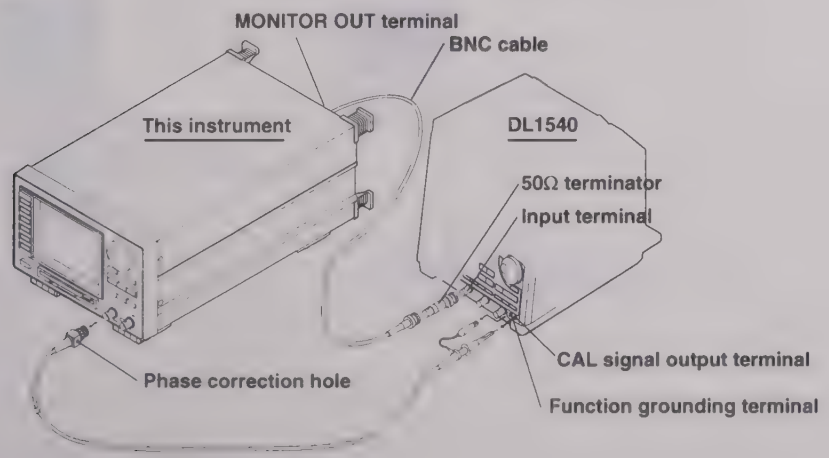
Connecting the Calibration Signal and Waveform Monitor

CAUTION

- Never apply a voltage exceeding the maximum input voltage to the input terminals. Damage to the input terminals may result.
- Never short-circuit the CAL signal output terminal of the DL1540 or the monitor output terminals (MONITOR OUT) of this instrument. Never apply an external voltage to these terminals. Damage to the internal circuits may result.

Make sure that the power to both this instrument and DL1540 is turned OFF, then connect them as shown below.

1. Use a BNC cable to connect the MONITOR OUT (CHA/CHB) terminal to an input terminal of the DL1540.
2. Connect the BNC connector of the probe to be calibrated to an input terminal of this instrument.
3. Connect the other end of probe to the CAL signal output terminal of the DL1540, and the grounding wire of the probe to the function grounding terminal of this instrument.



Procedure

1. Turn ON the power to both this instrument and DL1540.
2. Set the waveform acquisition conditions of the DL1540 so that the waveform of approximately two periods is observed clearly. For setting method, refer to the User's Manual of the DL1540.
3. Insert a screwdriver into the probe's phase correction hole, and turn the variable capacitor to produce correct square waves on the waveform monitor.

Explanation

Necessity of probe phase correction

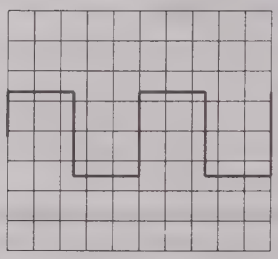
If the probe's input capacitance is out of the appropriate range, the gain will not be constant across different frequencies, preventing input of the correct waveforms. The input capacitance varies depending on the probe used, so the variable capacitor (trimmer) provided on the probe must be adjusted. This is called phase correction. Phase correction must be performed when the probe is to be used for the first time. Moreover, the appropriate input capacitance varies depending on which channel is used, so phase correction is required when the probe is switched from one channel to another.

Calibration signal

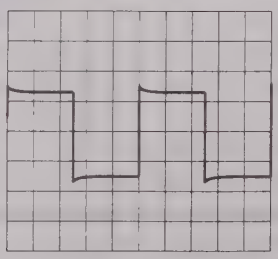
Waveform type: Square waveform
Frequency: 1 kHz
Voltage: 1 V_{p-p}

Waveform differences

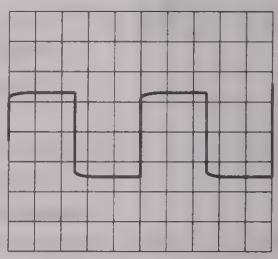
Correct waveform



Over-compensated (gain is too high at high frequency)



Under-compensated (gain is too low at high frequency)

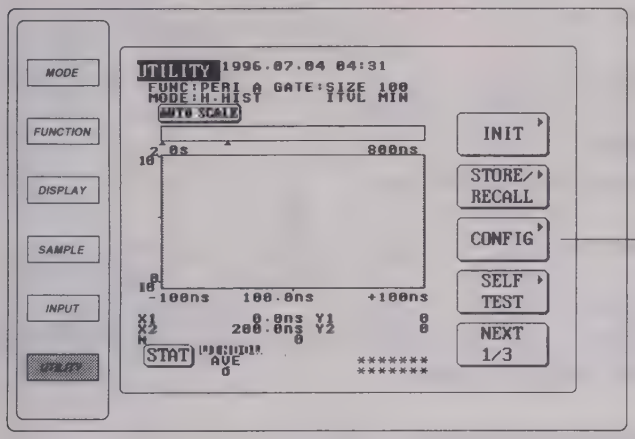


3.7 Setting the Date and Time

Procedure

- To exit from the current menu, press any of the top menu keys or press the ESC touch key displayed on the screen.

UTILITY Top menu



1. Press the UTILITY key to display the UTILITY top menu.
2. Press the CONFIG touch key to display the CONFIG menu.

Selecting the DATE/TIME menu

3. Press the DATE/TIME touch key to display the DATE/TIME menu.

Setting the date

4. Press the DATE touch key to highlight the key.
5. Use the rotary knob and arrow keys to set the desired date.

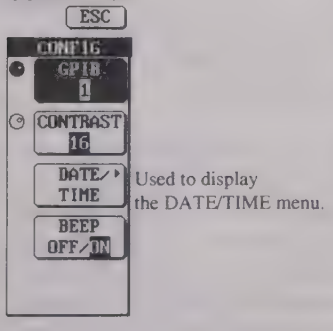
Setting the time

6. Press the TIME touch key to highlight the key.
7. Use the rotary knob and arrow keys to set the desired time.

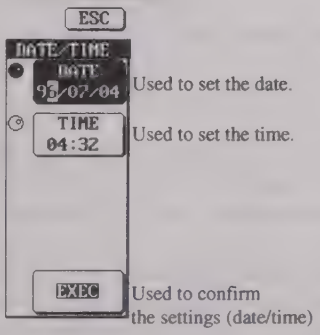
Confirming the date/time

8. Press the EXEC touch key to confirm the date and time.

CONFIG menu



DATE/TIME menu



Explanation

Setting the date

Set the date in order of year, month and day.

- Year
  Set the last two digits of the year. For instance, set "99" for 1999, "00" for 2000, "01" for 2001 and so on.
- Month
  Setting range: 01 to 12
- Day
  Setting range: 01 to 31

Setting the time

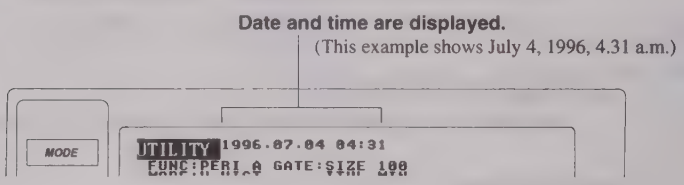
Set the time in order of hour and minute.

- Hour
  Setting range: 00 to 23
- Minute
  Setting range: 00 to 59

It is not possible to set or display seconds by the same method. However, "00" second is set when the EXEC touch key is pressed.

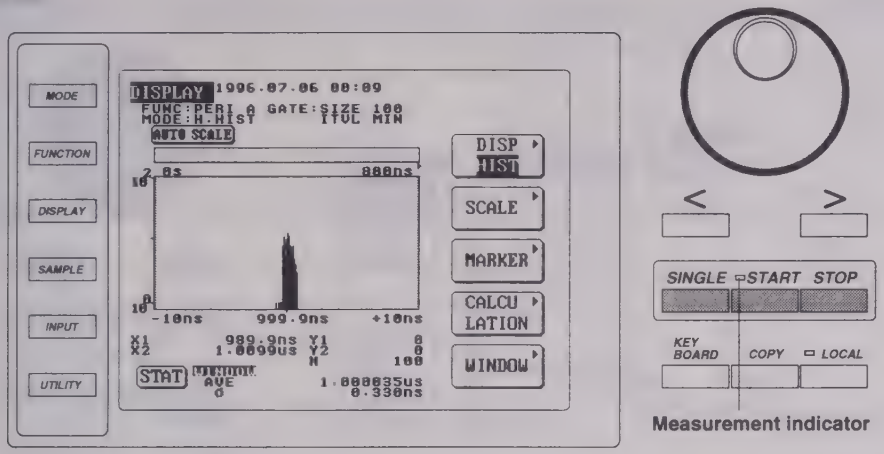
Display location of date/time

The date and time are displayed at the top of the screen.



4.1 Starting/Stopping Acquisition of a Measuring Input Signal

Procedure



When carrying out measurement continuously

- **Starting measurement**
  Press the START key to start measurement. The measurement indicator will light up.

- **Stopping measurement**
  Press the STOP key to stop measurement. The measurement indicator will go out.

When carrying out measurement only once

Press the SINGLE key. Measurement will stop automatically when measurement has been carried out once. The measurement indicator will light up while measurement is in progress, and will go out when measurement is complete.

Explanation

Continuous measurement

Once measurement is started, measurement will be carried out repeatedly until the STOP key is pressed.

Single measurement

Measurement is carried out each time the SINGLE key is pressed.

Note

- Each series of processes (measurement, data processing and display) is called a block (see 1.5).
- If the START (or SINGLE) key is pressed while the current one-block measurement is in progress, measured data acquired after the START (or SINGLE) key is pressed will be processed (i.e. displayed/computed).
- If the STOP key is pressed while the current one-block measurement is in progress, the data measured until the STOP key is pressed will be acquired and measurement will be stopped.
- An indicator is provided above each input terminal (CHA, CHB). The indicator should blink while a signal is input to the corresponding input terminal. If the indicator does not blink, check whether the trigger level is correct(see 6.1), whether the input cable is connected properly, or whether the signal is present. If the indicator does not blink even if a correct signal is input to the terminal, the instrument may be faulty. Contact your nearest YOKOGAWA representative listed on the rear cover of this manual.

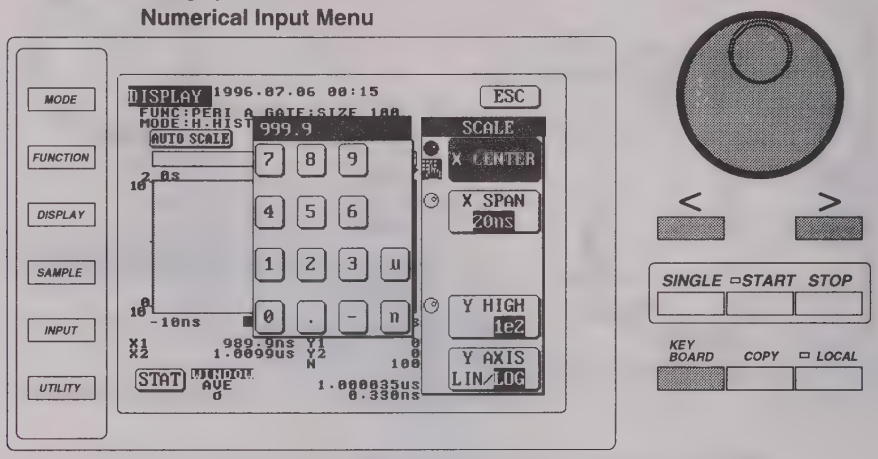
4.2 Setting Numerical Values

Procedure

≡For a description of the function, refer to 1.7≡

- To exit from the current menu, press any of the top menu keys or press the ESC touch key displayed on the screen.

Numerical Input Menu



Setting a numerical value using the ten-key

A numerical value can be entered using the ten-key while a small ten-key icon is displayed on the left of the currently highlighted touch key.

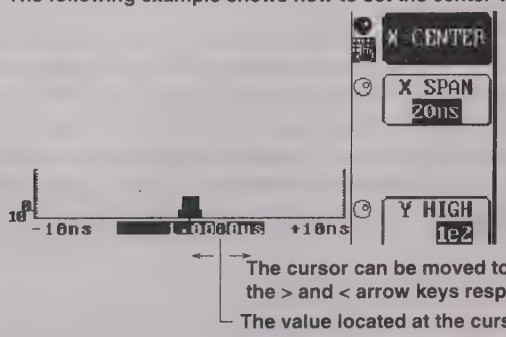
1. Press the KEYBOARD key to display the ten-key.
2. Press the ten-key to enter the desired numerical value.
3. To correct the entered numerical value, press the < key. Each time the < key is pressed, the value located on the left of the cursor will be deleted and the cursor moves to the left one digit.
4. After the unwanted value is deleted, use the ten-key to enter the correct value.
5. After the desired value has been entered, press the desired unit key then return touch key (see below). The ten-key will disappear, indicating the value has been confirmed.

Setting a numerical value using the rotary knob

A numerical value can be entered using the rotary knob if the highlighted touch key indicates a numerical item and a small rotary knob icon is displayed on the left of that highlighted touch key.

6. Press the arrow keys to move the cursor to the desired digit.
7. Turn the rotary knob to select the desired value. The selection of the value will be confirmed.
8. To correct the entered value, carry out steps 6 and 7.

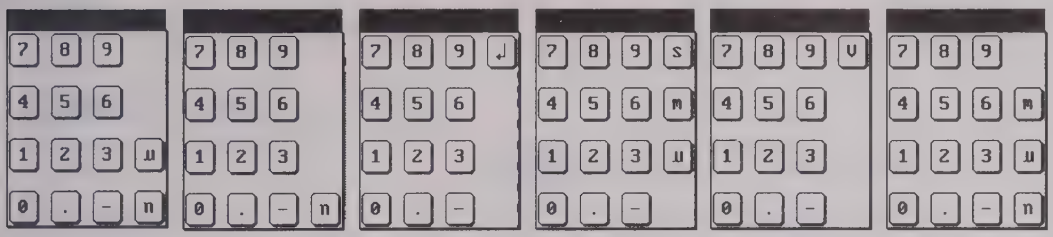
The following example shows how to set the center value of X-axis.


X CENTER
X SPAN
20ns
Y HIGH
1e2
-10ns
+10ns
The cursor can be moved to the right and left using the > and < arrow keys respectively.
The value located at the cursor is not highlighted.

Explanation

Setting a numerical value using the ten-key.

- The following six types of ten-key are available. The displayed ten-key varies according to the setting item.



- If a key (touch key, KEYBOARD key, > arrow key) is pressed or the rotary knob is turned before any of the following keys [S] [m] [μ] [n] [V] [↵] is pressed, the entered value will not be confirmed, but it will be canceled.

Note

- If an attempt is made to set a value higher than the allowed resolution for the item, the value will be rounded off.
- If an attempt is made to set a value exceeding the maximum value for the item, the maximum value will be set. Similarly, if an attempt is made to set a value below the minimum value for the item, the minimum value will be set.

Setting a numerical value using the rotary knob

- Only numerical values can be set using the rotary knob, whilst numerical values and unit can be set using the ten-key.
- The cursor will move to the next higher digit when the value at the cursor increases from 9 to 0. Similarly, the cursor will move to the next lower digit when the value at the cursor decreases from 0 to 9.

Note

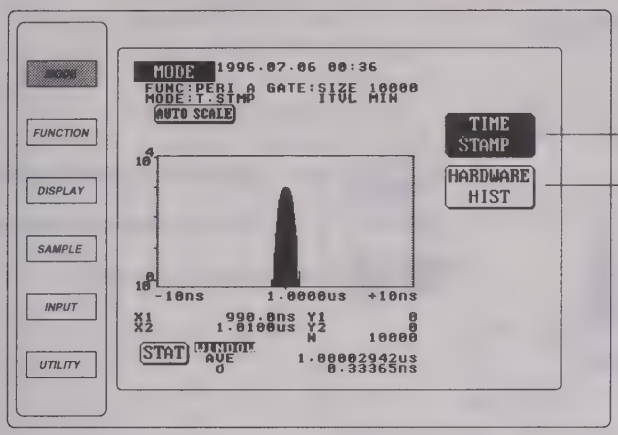
It is possible to reset the set value to the default setting (factory setting). For details, refer to 10.4 Note that this will reset all the set values to the default settings.

5.1 Selecting the Sampling Mode

Procedure

≡For a description of the function, refer to 1.2≡

MODE Top Menu



1. Press the MODE key to display the MODE top menu.

Selecting the time stamp mode

2. Press the TIME STAMP touch key to highlight TIME STAMP.

Selecting the hardware histogram mode

3. After step 1, Press the HARDWARE HIST touch key to highlight HARDWARE HIST.

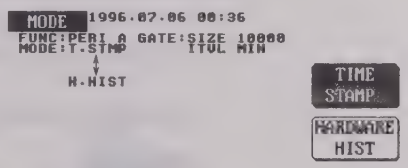
Explanation

Selecting the sampling mode

Either time stamp mode or hardware histogram mode can be selected.

- Time stamp mode: The measured value and time stamp are acquired.
- Hardware histogram mode: The measured value and its occurrence frequency are acquired.

T.STMP is displayed during time stamp mode, and H.HIST is displayed during hardware histogram mode.



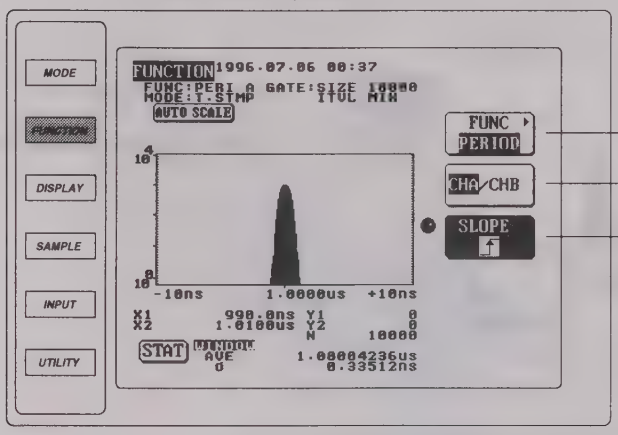
5.2 Setting Period Measurement

Procedure

≡For a description of the function, refer to 1.3≡

- To exit from the current menu, press any of the top menu keys or press the ESC touch key displayed on the screen.

FUNCTION Top Menu



1. Press the FUNCTION key to display the FUNCTION top menu.

Selecting period measurement

2. Press the FUNC touch key to display the measurement function menu.
3. Press the PERIOD touch key to select period measurement. The screen will return to the FUNCTION top menu when the PERIOD touch key is pressed.

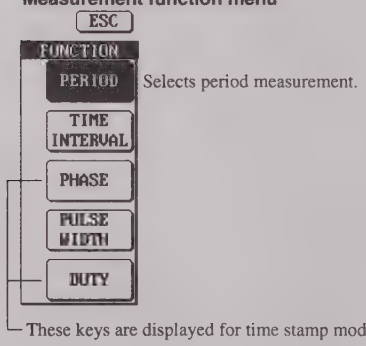
Selecting the channel to be used for measurement

4. Press the CHA/CHB touch key to select the desired channel (CHA or CHB). The highlighted channel (CHA or CHB) will be selected.

Selecting the slope (edge)

5. Press the SLOPE touch key to highlight SLOPE.
6. Turn the rotary knob to select the desired slope type.

Measurement function menu



Explanation

Measurement range

Measurement range varies according to the selected sampling mode.

- Time stamp mode: 30 ns to 100 ms
- Hardware histogram mode: 30 ns to 3.2 µs

Selecting the channel to be used for measurement

Select either CHA or CHB.

Selecting the slope (edge)

Select the desired slope from the following.

- ⌐↑ : Measures the time from a rising edge to the next rising edge of the input signal.
- ⌐↓ : Measures the time from a falling edge to the next falling edge of the input signal.

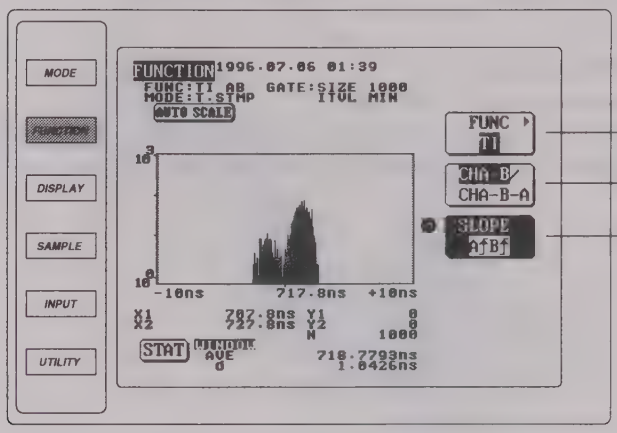
5.3 Setting Time Interval Measurement

Procedure

≡For a description of the function, refer to 1.3≡

- To exit from the current menu, press any of the top menu keys or press the ESC touch key displayed on the screen.

FUNCTION Top Menu



Displays the measurement function menu.

Selects the pattern.

Selects the slope (edge).

1. Press the FUNCTION key to display the FUNCTION top menu.

Selecting time interval measurement

2. Press the FUNC touch key to display the measurement function menu.
3. Press the TIME INTERVAL touch key to select time interval measurement. The screen will return to the FUNCTION top menu when the TIME INTERVAL touch key is pressed.

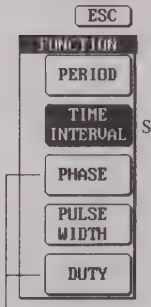
Selecting the pattern

4. Press the CHA/CHB touch key to select the desired pattern (CHA-B or CHA-B-A). The highlighted pattern (CHA-B or CHA-B-A) will be selected.

Selecting the slope (edge)

5. Press the SLOPE touch key to highlight SLOPE.
6. Turn the rotary knob to select the desired slope type.

Measurement function menu



Selects period measurement.

These keys are displayed for time stamp mode only.

Explanation

Measurement range

Measurement range varies according to the selected sampling mode and pattern.

- Time stamp mode:
  - CHA-B pattern : 5 ns to 100 ms
  - CHA-B-A pattern : 30 ns to 100 ms (for both A to B and B to A)
- Hardware histogram mode:
  - CHA-B pattern : 5 ns to 3.2 µs
  - CHA-B-A pattern : 30 ns to 3.2 µs (for both A to B and B to A)

Selecting the pattern

Select CHA-B or CHA-B-A.

- CHA-B: Measures A-to-B interval.
- CHA-B-A: Measures A-to-B-to-A interval. It is not possible to distinguish the measured data of A-to-B from that of B-to-A.

Selecting the slope (edge)

Slope (edge) types which can be selected vary according to the selected pattern.

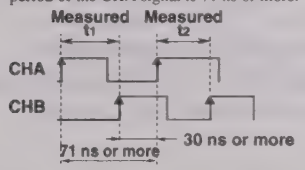
- CHA-B: Select the desired slope from the following.
  - A↑ B↑ : Measures the interval from a rising edge of the CHA signal (i.e. the signal which is input to the CHA) to the first rising edge of the CHB signal (i.e. the signal which is input to the CHB).
  - A↑ B↓ : Measures the interval from a rising edge of the CHA signal to the first falling edge of the CHB signal.
  - A↓ B↑ : Measures the interval from a falling edge of the CHA signal to the first rising edge of the CHB signal.
  - A↓ B↓ : Measures the interval from a falling edge of the CHA signal to the first falling edge of the CHB signal.
  - A↕ B↑ : Measures the interval from a rising or falling edge of the CHA signal to the first rising edge of the CHB signal. It is not possible to distinguish A↑ B↑ from A↓ B↑.
  - A↕ B↓ : Measures the interval from a rising or falling edge of the CHA signal to the to the first falling edge of the CHB signal. It is not possible to distinguish A↑ B↓ from A↓ B↓.

Note

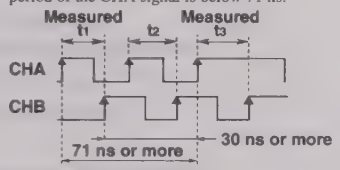
Measurement can be carried out continuously if the period of the CHA signal is 71 ns or more and the interval between an edge of the CHB signal and subsequent edge of the CHA signal is 30 ns or more.

Example A↑B↑

Measurement (t2) is carried out if the period of the CHA signal is 71 ns or more.



Measurement (t2) is not carried out but measurement (t3) is carried out if the period of the CHA signal is below 71 ns.



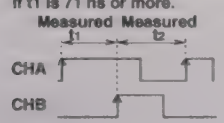
- CHA-B-A: Select the desired slope from the following.
  - A↑B↑A↑ : Measures the interval from a rising edge of the CHA signal to the first rising edge of the CHB signal, and the time interval from a rising edge of the CHB signal to the first subsequent rising edge of the CHA signal.
  - A↑B↓A↑ : Measures the interval from a rising edge of the CHA signal to the first falling edge of the CHB signal, and the time interval from a falling edge of the CHB signal to the first subsequent rising edge of the CHA signal.
  - A↓B↑A↓ : Measures the interval from a falling edge of the CHA signal to the first rising edge of the CHB signal, and the time interval from a rising edge of the CHB signal to the first subsequent falling edge of the CHA signal.
  - A↓B↓A↓ : A down B down A down: Measures the interval from a falling edge of the CHA signal to the first rising edge of the CHB signal, and the time interval from a rising edge of the CHB signal to the first subsequent falling edge of the CHA signal.

Note

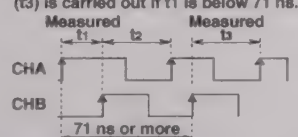
Measurement can be carried out continuously if the time interval (t1) from the CHA signal to the CHB signal is 71 ns or more.

Example A↑B↑A↑

Measurement (t2) is carried out if t1 is 71 ns or more.



Measurement (t2) is not carried out but measurement (t3) is carried out if t1 is below 71 ns.



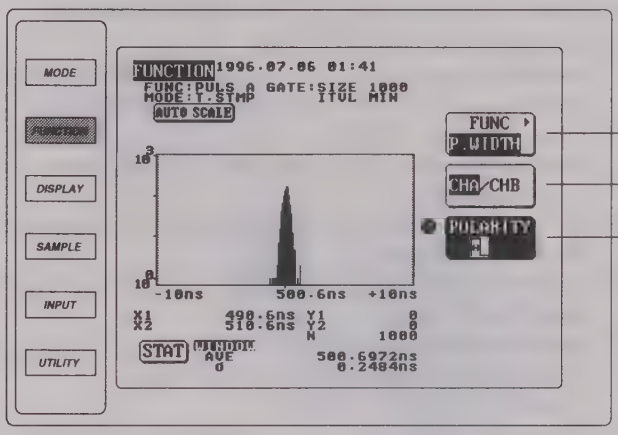
5.4 Setting Pulse Width Measurement

Procedure

≡For a description of the function, refer to 1.3≡

- To exit from the current menu, press any of the top menu keys or press the ESC touch key displayed on the screen.

FUNCTION Top Menu



Displays the measurement function menu.

Selects the channel to be used for measurement.

Selects a polarity.

1. Press the FUNCTION key to display the FUNCTION top menu.

Selecting pulse width measurement

2. Press the FUNC touch key to display the measurement function menu.
3. Press the PULSEWIDTH touch key to select pulse width measurement. The screen will return to the FUNCTION top menu when the PULSEWIDTH touch key is pressed.

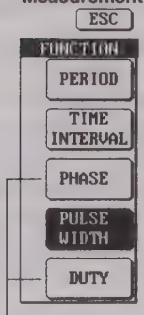
Selecting the channel to be used for measurement

4. Press the CHA/CHB touch key to select the desired channel (CHA or CHB). The highlighted channel (CHA or CHB) will be selected.

Selecting the polarity

5. Press the POLARITY touch key to highlight POLARITY.
6. Turn the rotary knob to select the desired polarity.

Measurement function menu



Selects pulse width measurement.

These keys are displayed for time stamp mode only.

Explanation

Measurement range

Measurement range varies according to the selected sampling mode.

- Time stamp mode: 30 ns to 100 ms
- Hardware histogram mode: 30 ns to 3.2 µs

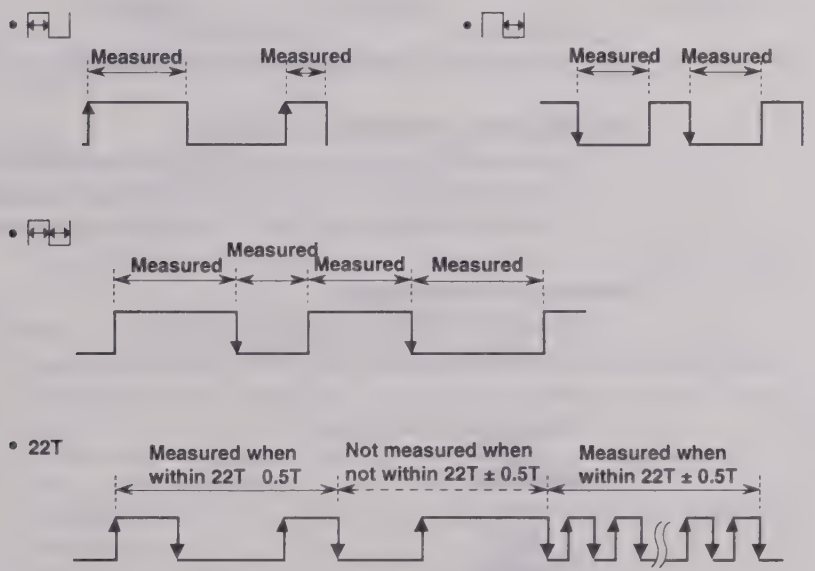
Selecting the channel to be used for measurement

Select either CHA or CHB.

Selecting the polarity

Select the desired polarity from the following.

- : Measures the positive pulse width (i.e. time from a rising edge to the next falling edge).
- : Measures the negative pulse width (i.e. time from a falling edge to the next rising edge).
- : Measures both positive and negative pulse widths. The positive and negative measured data can be displayed individually using the calculation menu of histogram display mode.
- **22T** : If PW (the total time of a few continuous periods) is within a range of 22T ± 0.5T, PW will be measured. This measurement can be selected only when time stamp mode has been selected. Constant T specified in 7.7 will be used as T.



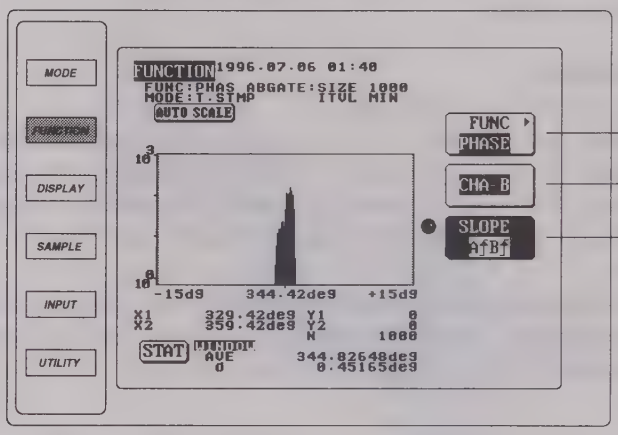
5.5 Setting Phase Difference Measurement

Procedure

≡For a description of the function, refer to 1.3≡

- To exit from the current menu, press any of the top menu keys or press the ESC touch key displayed on the screen.

FUNCTION Top Menu



Displays the measurement function menu.

CHA-B is always used as the pattern.

Selects the slope (edge).

1. Press the FUNCTION key to display the FUNCTION top menu.

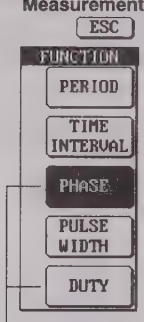
Selecting phase difference measurement

2. Press the FUNC touch key to display the measurement function menu.
3. Press the PHASE touch key to select phase difference measurement. The screen will return to the FUNCTION top menu when the PHASE touch key is pressed.

Selecting the slope (edge)

4. Press the SLOPE touch key to highlight SLOPE.
5. Turn the rotary knob to select the desired slope type.

Measurement function menu



Selects phase difference measurement.

These keys are displayed for time stamp mode only.

Explanation

Measurement range

Measurement range is shown below. This measurement is available only when time stamp mode has been selected.

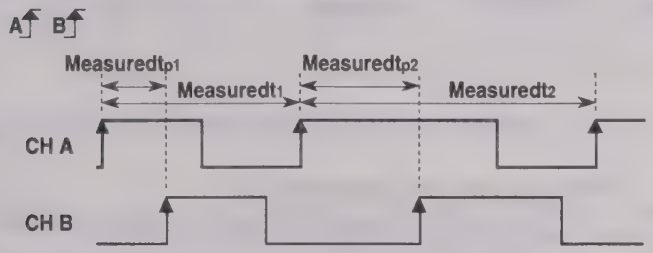
0 to 360 deg

Selecting the slope (edge)

Select the desired slope from the following.

- A↑ B↑ : Measures the time from a rising edge of the CHA signal to the first subsequent rising edge of the CHB signal.
- A↑ B↓ : Measures the time from a rising edge of the CHA signal to the first subsequent falling edge of the CHB signal.
- A↓ B↑ : Measures the time from a falling edge of the CHA signal to the first subsequent rising edge of the CHB signal.
- A↓ B↓ : Measures the time from a falling edge of the CHA signal to the first subsequent falling edge of the CHB signal.

Example (Both channels A and B: rise)



$$\text{Phase difference 1 [deg]} = \frac{t_{p1}}{t_1} \times 360 \qquad \text{Phase difference 2 [deg]} = \frac{t_{p2}}{t_2} \times 360$$

Note

- Phase difference measurement is not available if hardware histogram mode has been selected.
- The time from a rising or falling edge of the CHA signal to the first subsequent edge of the CHB signal must be 71 ns or more, otherwise incorrect measurement will result.
- The time from a rising or falling edge of the CHB signal to the first subsequent edge of the CHA signal must be 30 ns or more, otherwise incorrect measurement will result.
- t_p (phase difference) must be equal or smaller than t (period of the CHA signal), otherwise incorrect measurement will result.

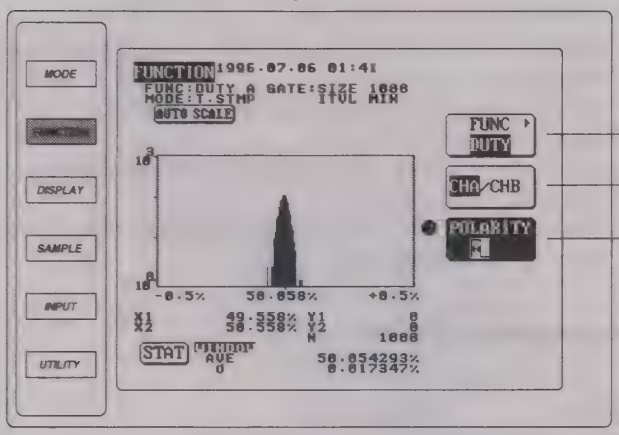
5.6 Setting Duty Ratio Measurement

Procedure

≡For a description of the function, refer to 1.3≡

- To exit from the current menu, press any of the top menu keys or press the ESC touch key displayed on the screen.

FUNCTION Top Menu



Displays the measurement function menu.

Selects the channel to be used for measurement.

Selects a polarity

1. Press the FUNCTION key to display the FUNCTION top menu.

Selecting duty ratio measurement

2. Press the FUNC touch key to display the measurement function menu.
3. Press the DUTY touch key to select duty ratio measurement. The screen will return to the FUNCTION top menu when the DUTY touch key is pressed.

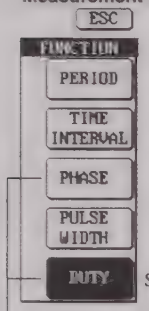
Selecting the channel to be used for measurement

4. Press the CHA/CHB touch key to select the desired channel (CHA or CHB). The highlighted channel (CHA or CHB) will be selected.

Selecting the polarity

5. Press the POLARITY touch key to highlight POLARITY.
6. Turn the rotary knob to select the desired polarity.

Measurement function menu



Selects duty ratio measurement.

These keys are displayed for time stamp mode only.

Explanation

Measurement range

Measurement range is shown below. This measurement is available only when time stamp mode has been selected.

0 to 99.999%

Selecting the channel to be used for measurement

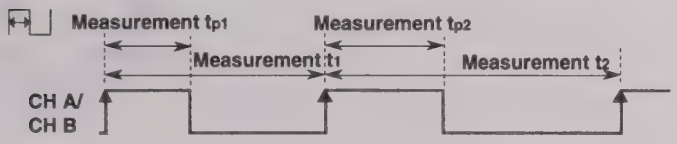
Select either CHA or CHB.

Selecting the polarity

Select the desired polarity from the following.

- ⊣⊢⌋ : Measures the positive duty ratio (i.e. from a rising edge to the next falling edge).
- ⌐⊢⊣ : Measures the negative duty ratio (i.e. from a falling edge to the next rising edge).

Example



$$\text{Duty ratio 1 [\%]} = \frac{t_{p1}}{t_1} \times 100 \qquad \text{Duty ratio 2 [\%]} = \frac{t_{p2}}{t_2} \times 100$$

Note

- Duty ratio measurement is not available if hardware histogram mode has been selected.
- t_{p1} must be 71 ns or more in the above example, otherwise incorrect measurement will result. In addition, incorrect measurement may also result if "$t_1 - t_{p1}$" is below 30 ns. This also applies when negative polarity is selected.

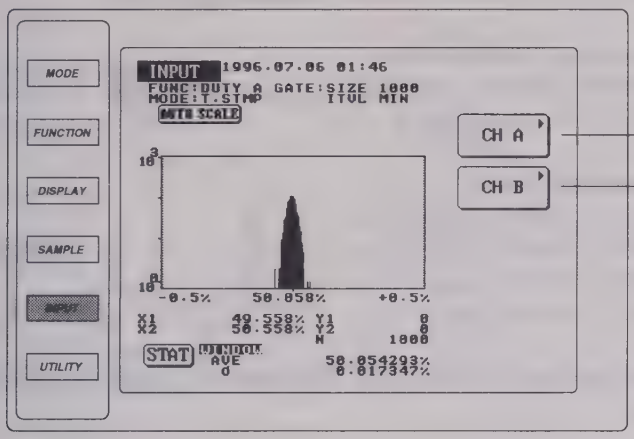
6.1 Setting the Input Coupling, Input Impedance, Trigger Mode and Trigger Level

Procedure

≡For a description of the function, refer to 1.5≡

- To exit from the current menu, press any of the top menu keys or press the ESC touch key displayed on the screen.

INPUT Top Menu



Displays the CHA input condition menu.

Displays the CHB input condition menu.

1. Press the INPUT key to display the INPUT top menu.

Selecting the channel to be set

2. Press the CHA or CHB touch key to select the desired channel. The input condition menu for the selected channel will be displayed.

Selecting the input impedance

3. Press the IMPD touch key to select the desired input impedance (50Ω or 1 MΩ). The highlighted input impedance (50Ω or 1 MΩ) will be selected.

Selecting the input coupling method

4. Press the COUPLING touch key to select the desired input coupling method (AC or DC). The highlighted input coupling method (AC or DC) will be selected.

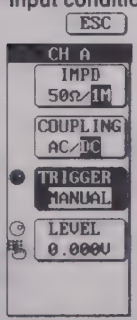
Selecting the trigger mode

5. Press the TRIGGER touch key to highlight TRIGGER.
6. Turn the rotary knob to select the desired trigger mode.

Setting the trigger level (required only when MANUAL trigger mode is selected)

7. Turn the rotary knob or press the ten-key to select the desired trigger level.

Input condition menu



(The same items are also displayed when CHB is selected.)

Selects the input impedance.

Selects the input coupling method.

Selects the trigger mode.

Selects the trigger level.

Explanation

Selecting the channel to be set

Select the input conditions individually for channels A and B.

Selecting the input impedance

Select 50Ωor 1 MΩ. If AC coupling is selected, frequency characteristic will vary depending on the selected input impedance. For details, refer to 12.1.

Selecting the input coupling method

Select AC or DC. Frequency characteristic will vary depending on the selected input coupling method. For details, refer to 12.1.

Selecting the trigger mode

Select the desired trigger mode from the following.

- SGL.AUTO : Single auto trigger mode.
- REP.AUTO : Repeat auto trigger mode.
- MANUAL : Manual trigger mode.

Setting the trigger level (required only when MANUAL trigger mode is selected)

Setting range : –5 V to +5 V

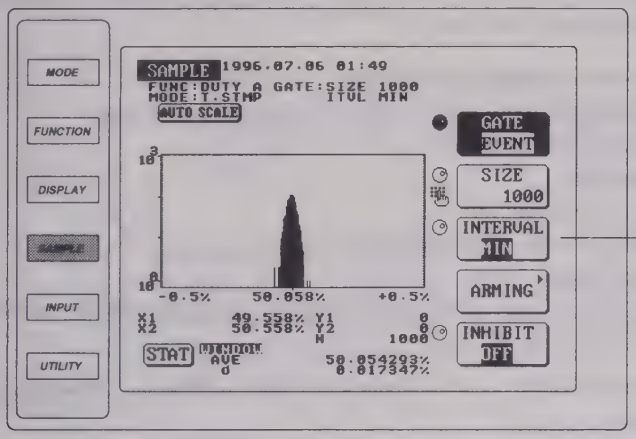
6.2 Setting the Gate Type, Sample Size and Sampling Interval

Procedure

≡For a description of the function, refer to 1.5≡

- To exit from the current menu, press any of the top menu keys or press the ESC touch key displayed on the screen.

SAMPLE Top Menu



Displayed only when time stamp mode is selected.

1. Press the SAMPLE key to display the SAMPLE top menu.

Selecting the gate type

2. Press the GATE touch key to highlight GATE.
3. Turn the rotary knob to select the desired gate type.

- **Setting the sample size (number of events) (required if EVENT gate type is selected at step 3)**

4. Press the SIZE touch key to highlight SIZE.
5. Turn the rotary knob or press the ten-key to set the desired number of events. Proceed to step 9.

- **Setting the gate time (required if TIME gate type is selected at step 3)**

6. After step 3, press the GATETIME touch key to highlight GATETIME.
7. Use the ten-key to set the desired gate time. After the desired gate time has been set, proceed to step 9.

- **Selecting the polarity (required if EXTERNAL gate type is selected at step 3)**

8. After step 3, press the POLARITY touch key to highlight ⎍ or ⎎. The highlighted polarity will be selected. After the desired polarity has been set, proceed to step 9.

Selecting the sampling interval

9. Press the INTERVAL touch key to highlight INTERVAL.
10. Turn the rotary knob to set the desired sampling interval.

Event gate menu

GATE EVENT	Selects the gate type.
SIZE 1000	Sets the sample size.
INTERVAL MIN	Selects the sampling interval. (Display for time stamp mode only.)
ARMING	
INHIBIT OFF	

Time gate menu

GATE TIME	Selects the gate type.
GATETIME 1.0000ms	Sets the gate time.
INTERVAL MIN	Selects the sampling interval. (Display for time stamp mode only.)
ARMING	
INHIBIT OFF	

External gate menu

GATE EXTERNAL	Selects the gate type.
POLARITY ⎍/⎎	Selects the polarity.
INTERVAL MIN	Selects the sampling interval. (Display for time stamp mode only.)
INHIBIT OFF	

Explanation

Selecting the gate type

Select the desired gate type from the following.

- EVENT : Event gate
- TIME : Time gate
- EXTERNAL : External gate. It is not possible to set the arming function or use the external arming signal if EXTERNAL is selected, since the external arming input terminal is shared with the external gate input signal.

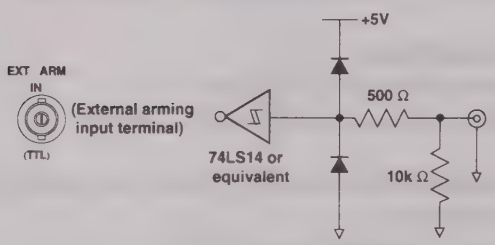
Points to note when selecting EXTERNAL

Input the external gating signal to the EXT ARM terminal on the rear panel.

- Input impedance : 10 kΩ (Typical *)
- Input coupling : DC
- Trigger level : TTL level
- Maximum input voltage : –8 V to 13 V (DC + AC_{peak})
- Minimum pulse width : 30 ns
- Setup time : 70 ns (in order for the gating signal to be valid, it must precede the measurement signal by no less than 70 ns)

* Typical value is described in terms of typical of average performance. However, they cannot be guaranteed.

External gate input circuit (shared with the external arming signal)



CAUTION

Never apply a voltage exceeding the maximum input voltage to the external arming input terminal (EXT ARM IN). Damage to the terminal may result.

Setting range for the number of events

The setting range varies according to the selected sampling mode. This setting is available only when EVENT gate is selected.

- For time stamp mode
  - Period, time interval or pulse width measurement : 1 to 32,000
  - Phase difference or duty ratio measurement :1 to 16,000
- For hardware histogram mode: 1 to 99,999,999

Note

Measurement of one block will be forced to end when 320 seconds (maximum sampling time) elapse following the arming, even if the number of events specified in sampling mode has not been reached.

Setting range for gate time

The gate time can be set within the following range. This setting is available only when TIME gate is selected.

1 μs to 10 s

Note

- Setting resolution varies depending on the value to be set. For details, refer to 12.2.
- Measurement of one block will be forced to end if the number of events for the block reaches the maximum number of events for the selected sampling mode even if the preset gate time has not been reached.

Selecting the polarity

Select the desired polarity from the following. This setting is available only when EXTERNAL gate is selected.

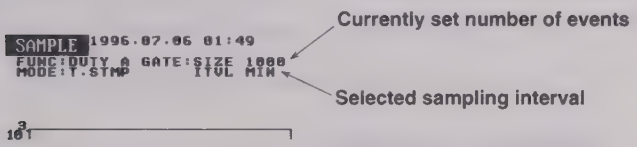
- ⎍ : Carries out measurement only when a positive signal is being input to the EXT ARM IN terminal.
- ⎎ : Carries out measurement only when a negative signal is being input to the EXT ARM IN terminal.

Note

Measurement of one block will be forced to end when the maximum number of events for the selected sampling mode is reached or when the maximum sampling time is exceeded, even if the external gate is still open.

Selecting the sampling interval

Select the desired sampling interval from the following. For hardware histogram mode, the sampling interval is fixed at MIN and cannot be set to another option.
MIN/1 µs/2 µs/4 µs/10 µs/20 µs/40 µs/100 µs/200 µs/400 µs/1 ms/2 ms/4 ms
MIN equals to 71 ns.



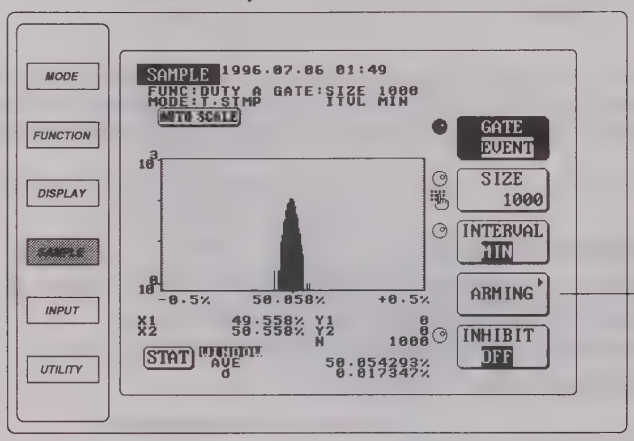
6.3 Setting the Arming Source, Slope and Delay Types

Procedure

≡For a description of the function, refer to 1.5≡

- To exit from the current menu, press any of the top menu keys or press the ESC touch key displayed on the screen.

SAMPLE Top Menu



Displays the arming menu. (This touch key is not displayed if EXTERNAL gate is selected)

1. Press the SAMPLE key to display the SAMPLE top menu.

Displaying the arming menu

2. Press the ARMING touch key to display the arming menu. This setting is not available (the ARMING touch key is not displayed) if EXTERNAL gate is selected.

Selecting the arming source

3. Press the SOURCE touch key to highlight SOURCE.
4. Turn the rotary knob to select the desired arming source.

If EXT (external arming) is selected at step 4, proceed to the following steps. If AUTO (auto arming) is selected, the following steps will not be available.

Selecting the slope (edge) (required only when EXT arming is selected)

5. Press the SLOPE touch key to highlight ↑ or ↓. The highlighted slope will be selected.

Selecting the arming delay type (required only when EXT arming is selected)

6. Press the DELAY touch key to highlight DELAY.
7. Turn the rotary knob to select the desired delay type.

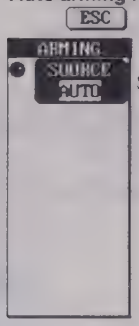
Setting the delay time (required only when TIME is selected at step 7)

8. Press the D.TIME touch key to highlight D.TIME.
9. Use the ten-key to set the desired delay time.

- **Setting the number of events (required only when EVENT is selected at step 7)**

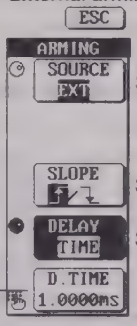
  10. After step 7, press the D.EVENT touch key to highlight D.EVENT.
  11. Turn the rotary knob to select the desired number of events.

Auto arming menu



Selects the arming source.

External arming menu



Selects the arming source.

Selects the slope.

Selects the arming delay type.

Sets the delay time/number of events.

No touch key is displayed if OFF is selected as the arming delay type, and D.EVENT touch key is displayed if EVENT is selected.

Explanation

Selecting the arming source

Selects the desired arming source from the following.

- AUTO : Auto arming
- EXT : External arming

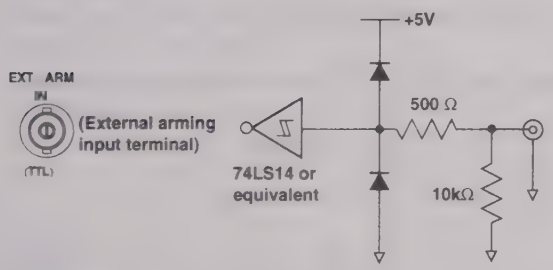
Points to note when selecting EXTERNAL

Input the external arming signal to the EXT ARM terminal on the rear panel.

- Input impedance : 10 kΩ (Typical *)
- Input coupling : DC
- Trigger level : TTL level
- Maximum input voltage : –8 V to 13 V (DC + AC_{peak})
- Minimum pulse width : 30 ns
- Setup time : 70 ns (in order for the arming signal to be valid, it must precede the measurement signal by no less than 70 ns)

* Typical value is described in terms of typical of average performance. However, they cannot be guaranteed.

External arming input circuit (shared with the external gating signal)



CAUTION

Never apply a voltage exceeding the maximum input voltage to the external arming input terminal (EXT ARM IN). Damage to the terminal may result.

Selecting the slope (edge)

Select the desired slope from the following. This is required only if EXT has been selected as the arming source.

- : Causes arming at a rising edge of the external arming signal.
- : Causes arming at a falling edge of the external arming signal.

Selecting the arming delay type

Select the desired arming delay type from the following. This setting is available only when EXT arming is selected.

- OFF : Selection/setting of arming delay is disabled. Arming delay will not be performed.
- TIME : Time delay
- EVENT : Event delay

- **Setting the delay time**

The delay time can be set within the following range. This setting is available only when TIME arming delay is selected.

1 μs to 1 s

Note

Setting resolution varies depending on the value to be set. For details, refer to 12.2.

- **Selecting the number of events to be delayed**

Select from the following. This setting is available only when EVENT arming delay is selected.

1/2/3/4/5/6/7/8/9/10/20/30/40/50/60/70/80/90/100/200/300/400/500/600/700/800/900/1000/2000/3000/4000/5000/6000/7000/8000/9000/10000/20000/30000

Note

The number of events to be delayed for the signal which is input to the measuring channel must be selected. However, for time interval measurement, the number of events to be delayed for the signal input to the channel A (CHA) must be selected.

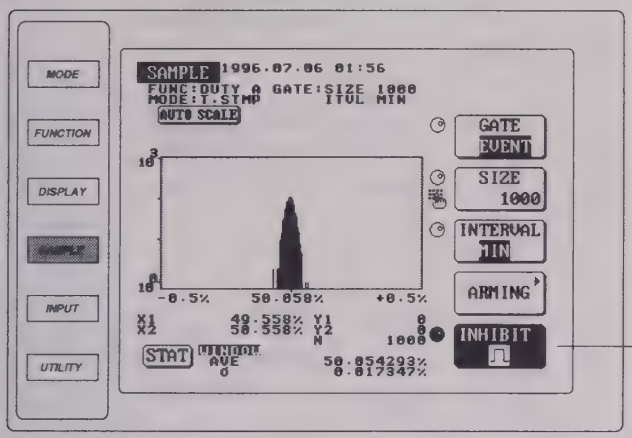
6.4 Setting the Inhibit Function

Procedure

≡For a description of the function, refer to 1.5≡

- To exit from the current menu, press any of the top menu keys.

SAMPLE Top Menu



Sets the inhibit function.

1. Press the SAMPLE key to display the SAMPLE top menu.
2. Press the INHIBIT touch key to highlight INHIBIT.
3. Turn the rotary knob to select the desired polarity.

Explanation

Selecting the polarity

Select the desired polarity from the following. The inhibit function is disabled if OFF is selected.

- : Inhibits measurement while a positive signal is input to the INHIBIT IN terminal.
- : Inhibits measurement while a negative signal is input to the INHIBIT IN terminal.

Note

The inhibit signal is valid only if it is input within just 320 seconds following the arming. It will not be valid if it is input after 320 seconds have elapsed following the arming.

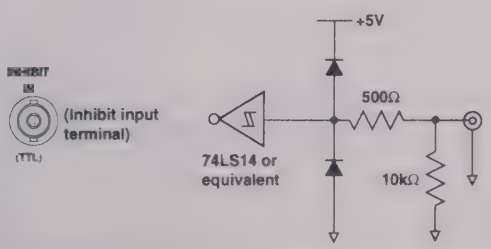
Points to note when inputting the inhibit signal

Input the inhibit signal to the INHIBIT IN terminal on the rear panel.

- Input impedance : 10 kΩ (Typical *)
- Input coupling : DC
- Trigger level : TTL level
- Maximum input voltage : –8 V to 13 V (DC + AC_{peak})
- Minimum pulse width : 30 ns
- Setup time : 70 ns (in order for the inhibit signal to be valid, it must precede the measurement signal by no less than 70 ns)

* Typical value is described in terms of typical of average performance. However, they cannot be guaranteed.

Inhibit input circuit



CAUTION

Never apply a voltage exceeding the maximum input voltage to the inhibit input terminal (INHIBIT IN). Damage to the terminal may result.

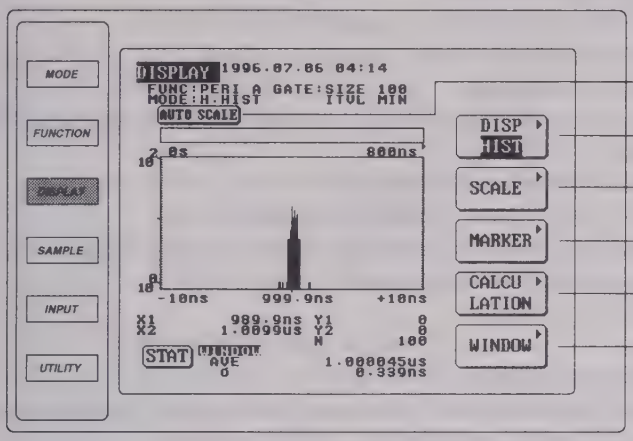
7.1 Setting the Histogram Display Function and Reading the Data (Readout)

Procedure

≡For a description of the function, refer to 1.4 and 1.6≡

- To exit from the current menu, press any of the top menu keys or press the ESC touch key displayed on the screen.

DISPLAY Top Menu



Performs auto scaling.
Displays the display format menu.
Displays the X-axis/Y-axis menu.
Displays the marker menu.
Displays the calculation menu.
Displays the multi-window menu. (displayed for hardware histogram mode only. Refer to 7.2.)

1. Press the DISPLAY key to display the DISPLAY top menu.

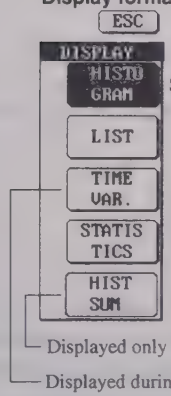
Selecting the histogram display function

2. Press the DISP touch key to display the display format menu.
3. Press the HISTOGRAM touch key to select the histogram display function. The screen will return to the DISPLAY top menu when the HISTOGRAM touch key is pressed.

Performing auto scaling

4. Press the AUTO SCALE touch key to perform auto scaling. The X-axis and Y-axis suitable for the input signal will be set automatically to display a histogram. The X-axis and Y-axis can be changed by carrying out steps 5 to 13. If it is not necessary to change the X-axis and Y-axis scaling, proceed to step 14.

Display format menu

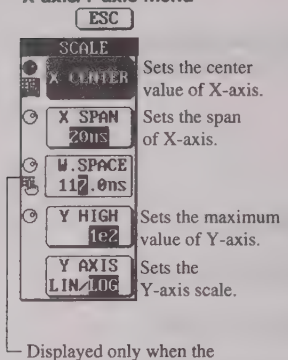


Selects the histogram display function.

Displayed only when the multi-window function is active (see 7.2).

Displayed during time stamp mode only.

X-axis/Y-axis menu



Setting the X-axis and Y-axis

5. Press the SCALE touch key to display the X-axis/Y-axis menu.

- **Setting the center value of X-axis**

6. Press the X CENTER touch key to highlight X CENTER.
7. Turn the rotary key or use the ten-key to set the desired center value of X-axis.

- **Selecting the span of X-axis**

8. Press the X SPAN touch key to highlight X SPAN.
9. Turn the rotary key to select the desired span of X-axis.

- **Selecting the Y-axis scale**

10. Press the Y AXIS touch key to highlight LIN or LOG. The highlighted scale will be selected.

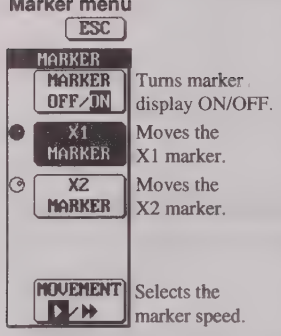
- **Selecting the maximum value of Y-axis**

11. Press the Y HIGH touch key to highlight Y HIGH.
12. Turn the rotary knob to select the desired maximum value of Y-axis.

- **Returning to the DISPLAY top menu**

13. Press the ESC touch key.

Marker menu



Setting readout parameters

14. From the DISPLAY top menu, press the MARKER touch key to display the marker menu.

- **Turning marker display ON/OFF**

15. Press the MARKER touch key of the marker menu, to highlight OFF or ON. The highlighted option (OFF or ON) will be selected. If OFF is selected, skip to step 23.

- **Moving the X1 marker**

16. Press the X1 MARKER touch key to highlight X1 MARKER.
17. Turn the rotary knob to move the X1 marker to the desired position.

- **Moving the X2 marker**

18. Press the X2 MARKER touch key to highlight X2 MARKER.
19. Turn the rotary knob to move the X2 marker to the desired position.

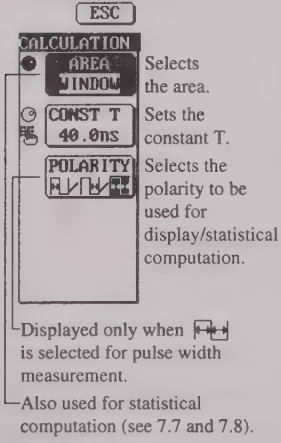
- **Selecting the marker speed**

20. Press the MOVEMENT touch key to highlight ▶▶. This will cause the marker to move faster.
21. Press the MOVEMENT touch key to highlight ▶. This will cause the marker to move at the original speed.

- **Returning to the DISPLAY top menu**

22. Press the ESC touch key.

Calculation menu



Setting the calculation function

23. From the DISPLAY top menu, press the CALCULATION touch key to display the calculation menu.

- **Selecting the area**

24. Press the AREA touch key to highlight AREA.
25. Turn the rotary knob to select the desired area.

- **Setting constant T**

26. Press the CONST T touch key to highlight CONST T.
27. Turn the rotary knob or use the ten-key to set the desired constant.

- **Selecting the polarity to be used for display/statistical computation (Required only if ⊢⊣ has been selected for pulse width measurement)**

28. Press the POLARITY touch key to highlight ⊢⊣, ⊓⊣ or ⊢⊣. The highlighted polarity will be selected.

Explanation

Selecting the histogram display function

From the display format menu, select HISTOGRAM.

Performing auto scaling

The X-axis and Y-axis will be set automatically so that the entire distribution of measured data can be displayed.

The X-axis and Y-axis scaling can be changed as described below.

Setting the X-axis and Y-axis

- **Setting range for center value of X-axis.**

  The setting range varies according to the selected measurement function.
  - Period, time interval or pulse width measurement: 10 ns to 99.9999900 ms (up to 3.19 µs in the case of hardware histogram mode)
  - Phase difference measurement: 15.00 to 345.00 deg
  - Duty ratio measurement: 0.500 to 99.500%

- **Selecting the span of X-axis**

  The span varies according to the selected measurement function.
  - Period, time interval or pulse width measurement: 2/4/10/20/40/100/200/400 ns, 1/2/4/10/20/40/100/200/400 µs, 1/2/4/10/20/40/100 ms (up to 3.2 µs in the case of hardware histogram mode)
  - Phase difference measurement: 30/60/90/180/360 deg
  - Duty ratio measurement: 1/5/10/50/100%

- **Selecting the Y-axis scale.**
  - LIN: Linear scale
  - LOG: Logarithmic scale

- **Selecting the maximum value of Y-axis**

  The maximum value of Y-axis varies according to the selected Y-axis scale.
  - LIN: 10/20/40/100/200/400/1000/2000/4000/10000/20000/40000/1e5/1e6/1e7/1e8 (up to 32000 in the case of time stamp mode)
  - LOG: 1e1/1e2/1e3/1e4/1e5/1e6/1e7/1e8 (e.g. 1e2 indicates 10^2.) (up to 1e5 in the case of time stamp mode)

Setting readout parameters

- **Turning marker display ON/OFF**
  - ON : Displays the markers.
  - OFF : Displays no markers. X1 MARKER, X2 MARKER and MOVEMENT touch keys are also not displayed.

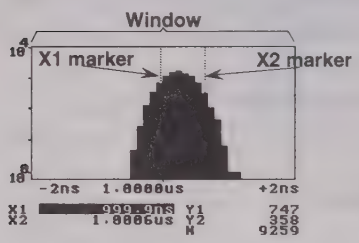
- **Movable range of X1 marker**

  The X1 marker can move about within the window, as long as it is located on the left of X2 marker. (They can be located in the same position.)

- **Movable range of X2 marker**

  The X2 marker can move about within the window, as long as it is located on the right of X1 marker. (They can be located in the same position.)

- **Selecting the marker speed**
  - ▶ : Causes the markers to move within the window every dot.
  - ▶▶ : Causes the markers to move within the window every 5 dots.



X1: X-axis coordinate of X1 marker
Y1: Y-axis coordinate of X1 marker (frequency of X1)
X2: X-axis coordinate of X2 marker
Y2: Y-axis coordinate of X2 marker (frequency of X2)
N:
- WINDOW calculation area: Total number of samples present within the window.
- MARKER calculation area: Number of samples present between X1 and X2 markers.

Note

With a certain center value and span of X-axis, markers may be located in an area which does not actually exist. For instance, if the center value of X-axis is set to 10 ns and span of X-axis is set to 3.2 µs, the window will contain minus measurement data area. If the markers are located in this area, asterisks "*" will be displayed instead of the X-axis coordinates.

Setting the calculation function

- **Selecting the area**

  Select WINDOW or MARKER. The item indicated by "N" at the bottom of the screen varies according to the selected calculation area.

- **Setting constant T**

  Setting range: 10 to 999.9 ns

- **Selecting the polarity to be used for display/statistical computation**

  This menu is displayed only if ⊢⊣ is selected for pulse width measurement. Select the desired polarity from the following to be used for display (histogram, time variation) or statistical computation.
  - ⊢⊣ : Displays or performs statistical computation for the positive side only.
  - ⊢⊣ : Displays or performs statistical computation for the negative side only.
  - ⊢⊣ : Displays or performs statistical computation for the both positive and negative sides. However, computation will be performed for the standard deviation and jitter1 only. For details, refer to 7-7.

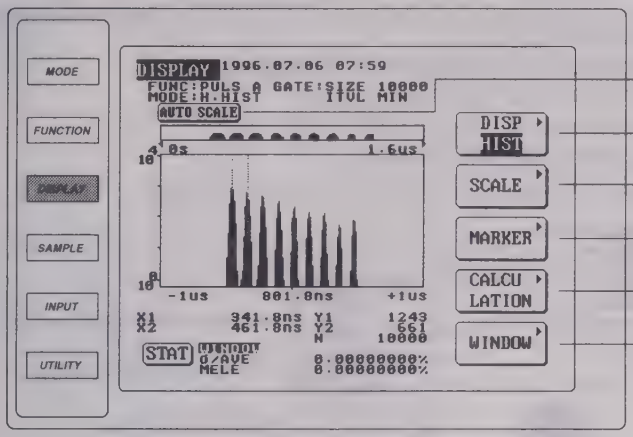
7.2 Using the Multi-window Function

Procedure

≡For a description of the function, refer to 1.6≡

- To exit from the current menu, press any of the top menu keys or press the ESC touch key displayed on the screen.

DISPLAY Top Menu



- Performs auto scaling.
- Displays the display format menu.
- Displays the X-axis/Y-axis menu.
- Displays the marker menu.
- Displays the calculation menu.
- Displays the multi-window menu. (displayed for hardware histogram mode only)

1. Press the DISPLAY key to display the DISPLAY top menu.

Selecting the histogram display function

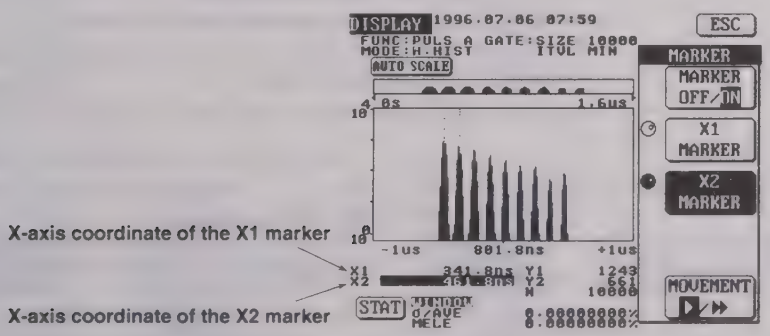
2. Select the histogram display function as described in 7.1.

Performing auto scaling

3. Perform auto scaling as described in 7.1.

Preparation before using the multi-window function

4. Press the MARKER touch key of the DISPLAY top menu to display the marker menu.
5. Press the MARKER touch key of the marker menu to highlight ON.
6. Some histograms will be displayed on the screen. Move the X1 marker to the highest frequency position of the left most histogram by turning the rotary knob, and read and record the X-axis coordinate of the X1 marker.
7. Next, move the X2 marker to the highest frequency position of the second histogram from the left by turning the rotary knob, read the X-axis coordinate of the X2 marker, then read and record the displacement from the X1 marker.
8. Press the ESC touch key to return to the DISPLAY top menu.



Setting the multi-window function

9. Press the WINDOW touch key of the DISPLAY top menu to display the multi-window menu.

- **Selecting multi-window**

10. Press the SINGLE/MULTI touch key to highlight MULTI. The MODE and SIZE touch keys will appear.

- **Selecting the multi-window mode**

11. Press the MODE touch key to highlight AUTO or MAN. The highlighted mode (AUTO or MAN) will be selected.

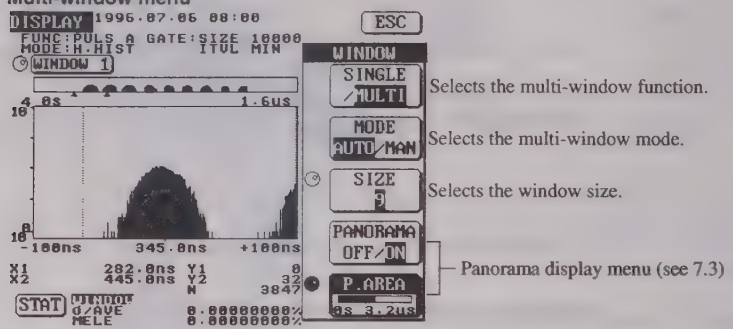
- **Selecting the window size (number of windows)**

12. Press the SIZE touch key to highlight SIZE.
13. Turn the rotary knob to set the desired window size.

- **Returning to the DISPLAY top menu**

14. Press the ESC touch key to return to the DISPLAY top menu.

Multi-window menu



Setting the X-axis and Y-axis

15. Press the SCALE touch key to display the X-axis/Y-axis menu.

- **Setting the center value of X-axis**

16. Press the X CENTER touch key to highlight X CENTER.
17. Turn the rotary key or use the ten-key to set the desired center value of X-axis for window 1. The value recorded at step 6 (the X-axis coordinate of the X1 marker) must be set.

- **Selecting the span of X-axis**

18. Press the X SPAN touch key to highlight X SPAN.
19. Turn the rotary key to select the desired span of X-axis. By referring to the value recorded at step 7 (the displacement of the X2 marker from X1 marker), set the span so that the entire histogram to be analyzed is positioned inside the window.

- **Setting the space between the center values of X-axis (required only when AUTO multi-window mode is selected)**

20. Press the W.SPACE touch key to highlight W.SPACE.
21. Turn the rotary key or use the ten-key to set the space between the center value of X-axis for a window and that for other windows. The value recorded at step 7 (the displacement of the X2 marker from X1 marker) must be set.

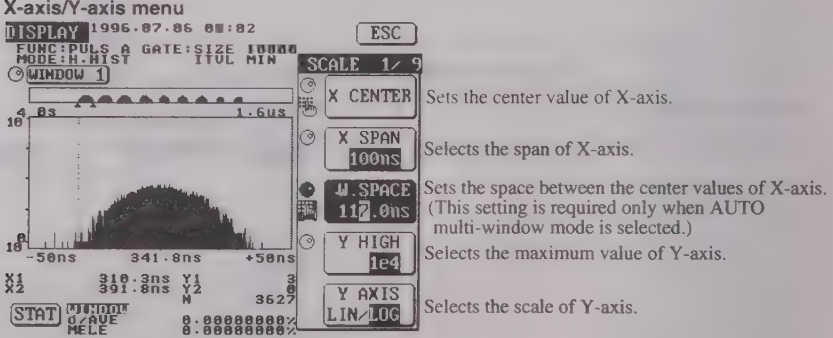
- **Selecting the scale and maximum value of Y-axis**

22. Select the scale and maximum value of Y-axis, if necessary. For the selection method, refer to 7.1.

- **Re-setting the X-axis and Y-axis**

23. Repeat steps from 15 until the histogram can be observed clearly and easily.

X-axis/Y-axis menu



Observing other windows

24. Press the WINDOW selection touch key (WINDOW 1 in the example given on page 7-6) displayed at the upper left corner to highlight WINDOW.
25. Turn the rotary knob to select the desired window. Up to the window size (i.e. number of windows) specified at steps 12 and 13 can be selected. The X-axis/Y-axis menu varies according to the multi-window mode selected at step 11. For details, refer to "Explanation" given on this page.

Explanation

Preparation before using the multi-window function

If more than two histograms exist and the distribution range of each histogram is not known, turn OFF the multi-window function and perform auto scaling. The multi-window function can be turned OFF as described below.

- Turning OFF the multi-window function
  Press the SINGLE/MULTI touch key to highlight SINGLE. The MODE and SIZE touch keys will disappear, indicating that the multi-window function has been turned OFF.
- Marker positions (X1 and X2 markers) were recorded at steps 6 and 7. They are referred to when determining the X-axis for multi-window. Turn ON the multi-window function, and re-sets the X-axis and Y-axis as described at step 23 so that the histogram can be observed clearly and easily.

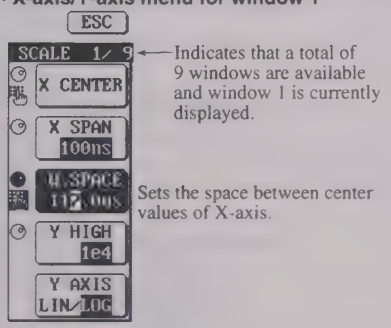
Setting the multi-window function

The multi-window function can be set only when hardware histogram mode is selected as the sampling mode.

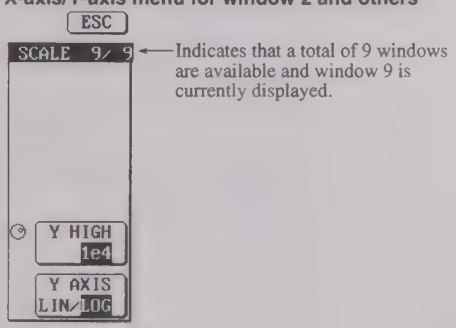
- **Selecting multi-window**
  - SINGLE: Turns OFF the multi-window function. The MODE and SIZE touch keys will not be displayed.
  - MULTI: Turns ON the multi-window function. The MODE and SIZE touch keys will be displayed.
- **Selecting the multi-window mode**
  This setting is available when MULTI is selected. Select the method of setting the X-axis for each window.
  - AUTO: Applies the span of X-axis set for window 1 using the X-axis/Y-axis menu to window 2 and other windows. A menu for setting the space between center values of X-axis will appear, as shown below.
  - MAN: Allows the user to set the center value and span of X-axis for each window individually using the X-axis/Y-axis menu. The menu for setting the space between center values of X-axis will not appear.

When AUTO multi-window mode is selected

• X-axis/Y-axis menu for window 1

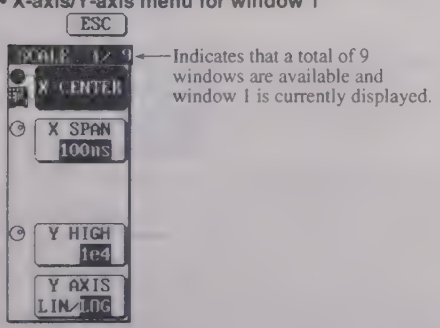


• X-axis/Y-axis menu for window 2 and others

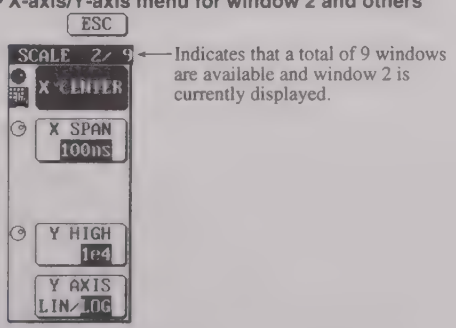


When MANU multi-window mode is selected

• X-axis/Y-axis menu for window 1



• X-axis/Y-axis menu for window 2 and others



- **Selecting the window size (number of windows)**

  Up to 16 windows can be set if the multi-window function is ON.

  Setting range: 1 to 16

Setting the X-axis and Y-axis

For the setting method for center value of X-axis, span of X-axis, Y-axis scale, maximum value of Y-axis and area, refer to 7.1.

If MULTI is selected, use the W.SPACE touch key of the X-axis/Y-axis menu to set the space between the center value of X-axis for a window and that for other windows. The W.SPACE touch key is displayed if AUTO is selected as the multi-window mode.

Setting range for the space between the center values of X-axis: 0 to 250 ns

Note

If AUTO is selected as the multi-window mode, the histogram containing the smallest measured data must be used to set the X-axis and Y-axis for window 1. For the space between the center values of X-axis, only a positive displacement is set. Thus, if a histogram contains measured data smaller than that contained in the histogram used for window 1, no window will be assigned to that histogram. As a result, this histogram will not be displayed even if the window is switched to another at steps 24 and 25.

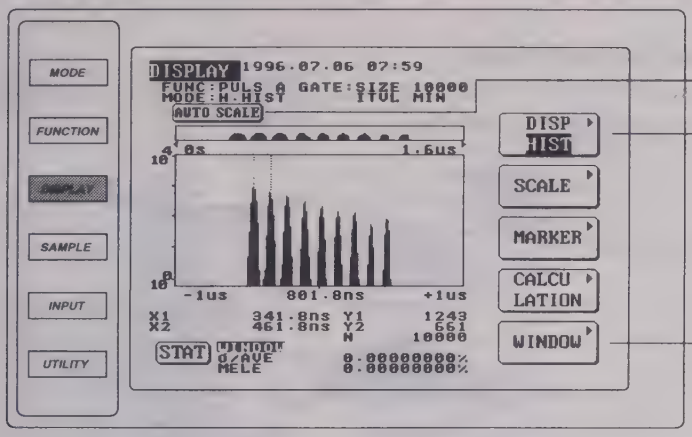
7.3 Using the Panorama Display Function

Procedure

≡For a description of the function, refer to 1.6≡

- To exit from the current menu, press any of the top menu keys or press the ESC touch key displayed on the screen.

DISPLAY Top Menu



1. Press the DISPLAY key to display the DISPLAY top menu.

Selecting the histogram display function

2. Select the histogram display function as described in 7.1.

Performing auto scaling

3. Perform auto scaling as described in 7.1.

Setting the panorama display function

4. Press the WINDOW touch key to display the multi-window menu.

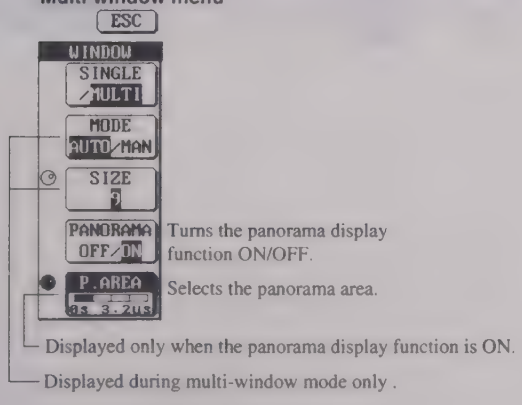
- **Turning the panorama display function ON/OFF**

5. Press the PANORAMA touch key to highlight OFF or ON. The highlighted option (OFF or ON) will be selected. In this example, highlight ON to select it.

- **Selecting the panorama area**

6. Press the P.AREA touch key to highlight P.AREA.
7. Turn the rotary knob to select the desired panorama area.

Multi-window menu



Explanation

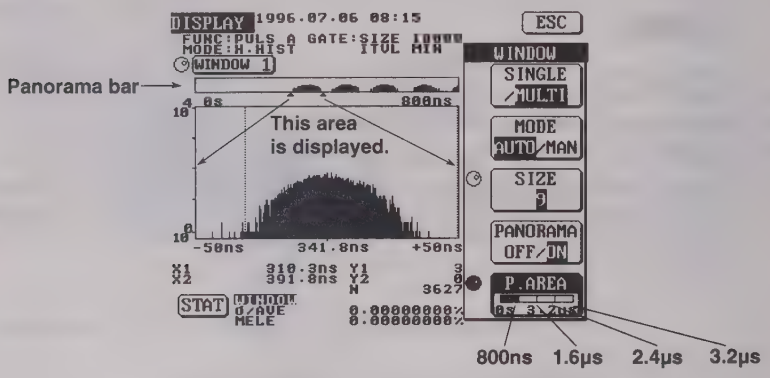
The panorama display function is available only when hardware histogram mode is selected as the sampling mode.

Turning the panorama display function ON/OFF

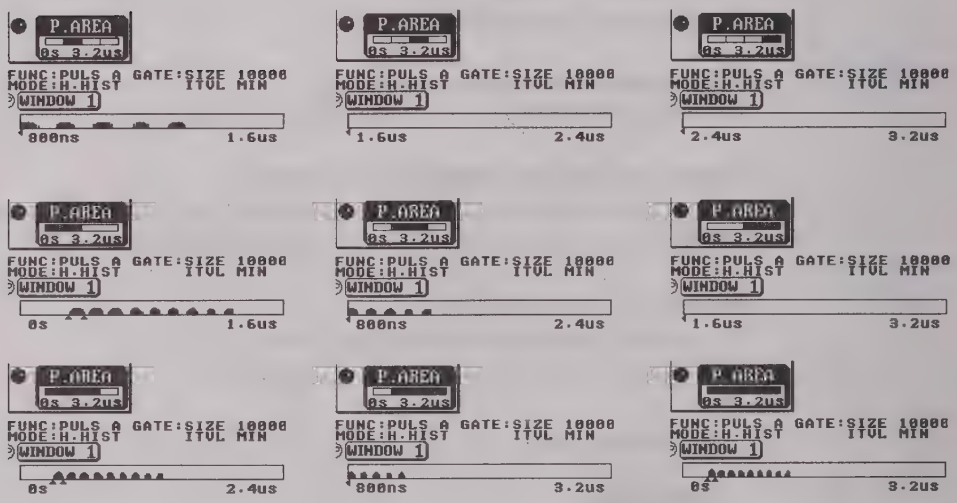
- OFF: Does not display the panorama bar. The P.AREA touch key will not be displayed.
- ON: Displays the panorama bar. The P.AREA touch key will be displayed.

Selecting the panorama area

- 0 to 3.2 µs is divided into four panorama areas, to allows the user to select a panorama area from a total of 10 area combinations.



- Turning the rotary knob while P.AREA is highlighted will switch the panorama area from one to another as shown below.



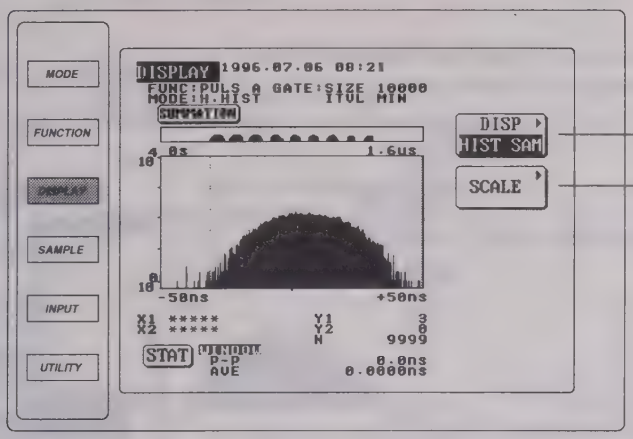
7.4 Carrying out Histogram Data Addition

Procedure

≡For a description of the function, refer to 1.6≡

- To exit from the current menu, press any of the top menu keys or press the ESC touch key displayed on the screen.

DISPLAY Top Menu



1. Press the DISPLAY key to display the DISPLAY top menu.

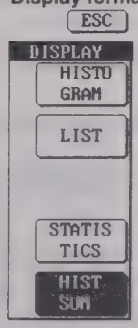
Selecting multi-window

2. Select the multi-window as described in 7.2. Select AUTO as the multi-window mode.

Selecting the histogram data addition function

3. Press the DISP touch key to display the display format menu.
4. Press the HIST SUM touch key to select the histogram data addition function. The screen will return to the DISPLAY top menu when the HIST SUM touch key is pressed.

Display format menu



Selects the histogram data addition function.
(displayed only when the multi-window function is ON).

Setting the Y-axis

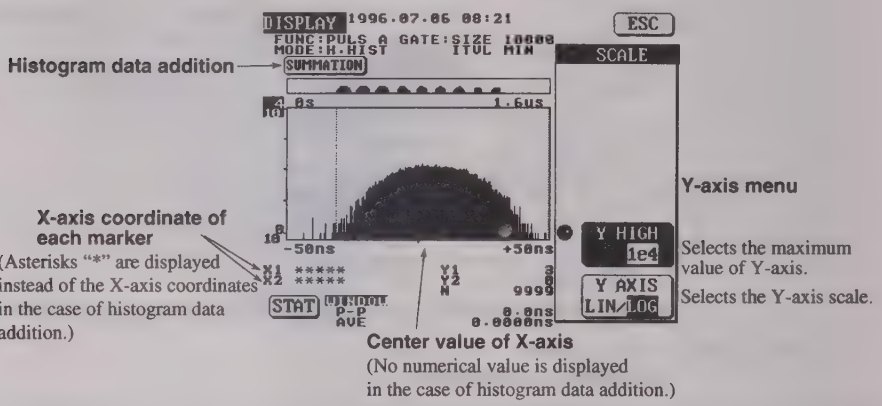
5. Press the SCALE touch key to display the Y-axis menu.

- **Selecting the Y-axis scale**

6. Press the Y AXIS touch key to highlight LIN or LOG. The highlighted scale will be selected.

- **Selecting the maximum value of Y-axis**

7. Press the Y HIGH touch key to highlight Y HIGH.
8. Turn the rotary knob to select the desired maximum value of Y-axis.



Explanation

The histogram data addition is available only when the multi-window function is ON and AUTO is selected as the multi-window mode.

Histogram data addition

- The frequency of all the windows (i.e. windows set using the SIZE touch key during multi-window setting) is added.
- The frequency of the bin located within the span of X-axis and at the relatively same position to the center value of X-axis is added.
- The center value and marker's X-axis coordinate are not displayed since they exist for each window, thus displaying them is meaningless.
- Y1 and Y2 (frequency of each marker) indicates the frequency obtained after addition is carried out.
- N indicates the number of samples obtained after addition is carried out. Whether N indicates the number of samples present in the entire window or within the area enclosed by the markers is determined by the calculation area set in 7.1.

Setting the Y-axis

Refer to "Explanation" given in 7.1.

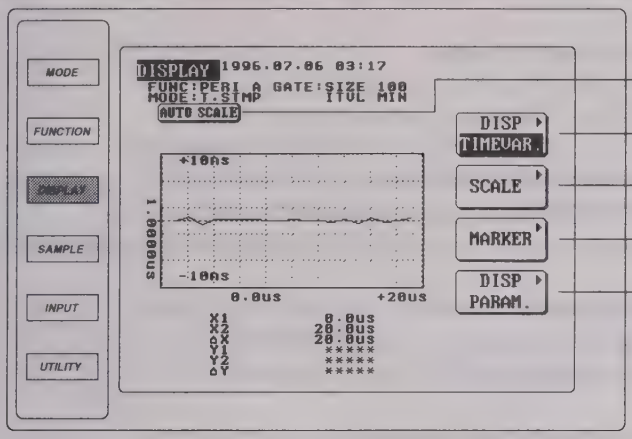
7.5 Setting the Time Variation Display Function and Reading the Data (Readout)

Procedure

≡For a description of the function, refer to 1.4 and 1.6≡

- To exit from the current menu, press any of the top menu keys or press the ESC touch key displayed on the screen.

DISPLAY Top Menu



1. Press the DISPLAY key to display the DISPLAY top menu.

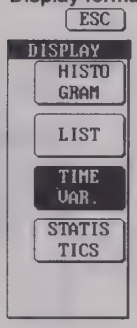
Selecting the time variation display function

2. Press the DISP touch key to display the display format menu.
3. Press the TIMEVAR. touch key to select the time variation display function.
   The screen will return to the DISPLAY top menu when the TIMEVAR. touch key is pressed.

Performing auto scaling

4. Press the AUTO SCALE touch key to perform auto scaling. The X-axis and Y-axis suitable for the input signal will be set automatically to display time variation. The X-axis and Y-axis can be changed by carrying out steps 5 to 14. If it is not necessary to change the X-axis and Y-axis scaling, proceed to step 15.

Display format menu



Selects the time variation display function. (display for time stamp mode only).

Setting the X-axis and Y-axis

5. Press the SCALE touch key to display the X-axis/Y-axis menu.

- **Setting the minimum value of X-axis**

6. Press the X MIN touch key to highlight X MIN.
7. Turn the rotary key or use the ten-key to set the desired minimum value of X-axis.

- **Selecting the span of X-axis**

8. Press the X SPAN touch key to highlight X SPAN.
9. Turn the rotary key to select the desired span of X-axis.

- **Setting the center value of Y-axis**

10. Press the Y CENTER touch key to highlight Y CENTER.
11. Turn the rotary key or use the ten-key to set the desired center value of Y-axis.

- **Selecting the span of Y-axis**

12. Press the Y SPAN touch key to highlight Y SPAN.
13. Turn the rotary key to select the desired span of Y-axis.

- **Returning to the DISPLAY top menu**

14. Press the ESC touch key.

Setting readout parameters

15. Set readout parameters using the marker menu as described in 7.1.

Selecting the display parameters (from the DISPLAY top menu)

16. Press the DISP PARAM. touch key to display the display parameter menu.

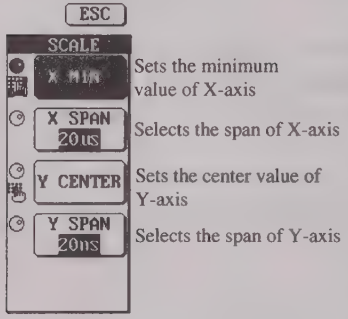
- **Turning grid display ON/OFF**

17. Press the GRID touch key to highlight OFF or ON. The highlighted option (OFF or ON) will be selected.

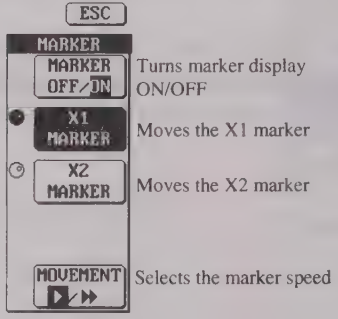
- **Turning interpolation display ON/OFF**

18. Press the CONNECT touch key to highlight OFF or ON. The highlighted option (OFF or ON) will be selected.

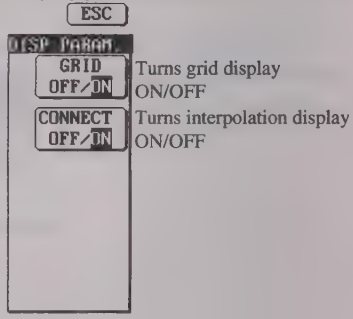
X-axis/Y-axis menu



Marker menu



Display parameter menu



Explanation

The time variation display function is available only when time stamp mode is selected as the sampling mode.

Selecting the time variation display function

From the display format menu, select TIME VAR. The time stamp resolution (X-axis) is 100 ns.

Performing auto scaling

Refer to 7.1.

Setting the X-axis and Y-axis

- **Setting range for the minimum value of X-axis**

  The minimum value of X-axis can be set within the following range.
  0 to 199.9999800 sec.

- **Selecting the span of X-axis**

  Select from the following.
  20/40/100/200/400 µs, 1/2/4/10/20/40/100/200/400 ms, 1/2/4/10/20/40/100/200 sec.

- **Setting range for the center value of Y-axis**

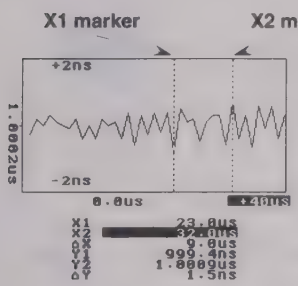
  The setting range varies according to the selected measurement function.
  - Period, time interval or pulse width measurement: 10 ns to 99.9999900 ms
  - Phase difference measurement: 15.00 to 345.00 deg
  - Duty ratio measurement: 0.500 to 99.500%

- **Selecting the span of Y-axis**

  The span varies according to the selected measurement function.
  - Period, time interval or pulse width measurement: 2/4/10/20/40/100/200/400 ns, 1/2/4/10/20/40/100/200/400 µs, 1/2/4/10/20/40/100 ms
  - Phase difference measurement: 30/60/90/180/360 deg
  - Duty ratio measurement: 1/5/10/50/100%

Setting readout parameters

For the setting method for maker display, movable range and speed, refer to 7.1.
The meaning of each value displayed is given below.



X1: X-axis coordinate of X1 marker (time stamp)
X2: X-axis coordinate of X2 marker (time stamp)
ΔX: X2 – X1
Y1: Y-axis coordinate of X1 marker (measured data)
Y2: Y-axis coordinate of X2 marker (measured data)
ΔY: |Y2 – Y1|

Note

- If more than two data exist in the marker position, the average value of those data will be displayed.
- If no data exists in the marker position, asterisks "*" will be displayed.

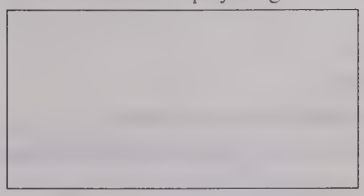
Selecting the display parameters

When the time variation display function is ON, it is possible to select whether or not to display the grid in the window. In addition, it is also possible to select whether or not to interpolate (i.e. connect) measurement points.

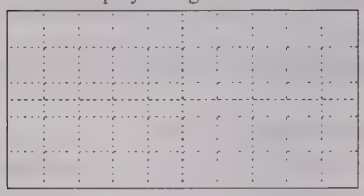
- **Turning grid display ON/OFF**

  Select ON or OFF.

  - OFF: Does not display the grid.



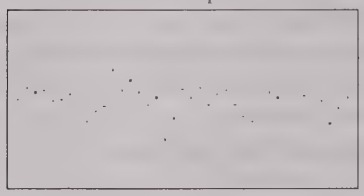
  - ON: Displays the grid.



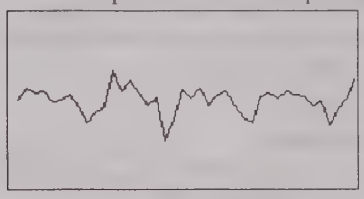
- **Turning interpolation display ON/OFF**

  Select ON or OFF.

  - OFF: Does not interpolate measurement points.



  - ON: Interpolates measurement points.



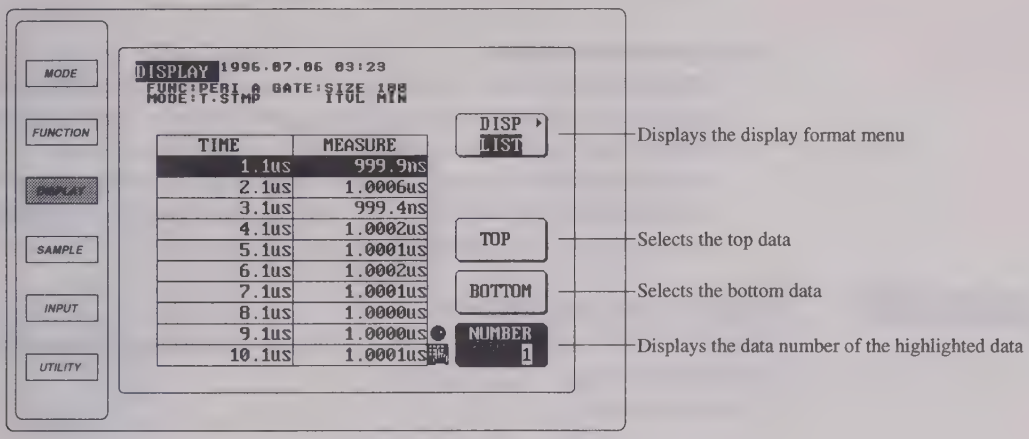
7.6 Selecting the List Display Function and Displaying the Data

Procedure

≡For a description of the function, refer to 1.6≡

- To exit from the current menu, press any of the top menu keys or press the ESC touch key displayed on the screen.

DISPLAY Top Menu



1. Press the DISPLAY key to display the DISPLAY top menu.

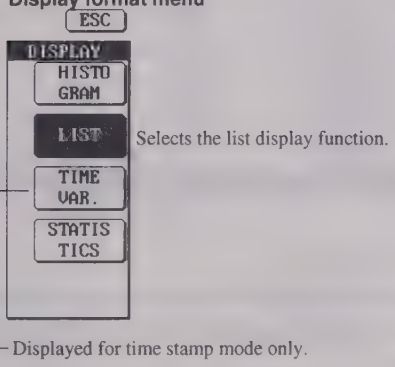
Selecting the list display function.

2. Press the DISP touch key to display the display format menu.
3. Press the LIST touch key to select the list display function.
   The screen will return to the DISPLAY top menu when the LIST touch key is pressed.

Setting the data to be displayed in a list

4. Turn the rotary knob or use the ten-key to select the data to be displayed in a list. The value displayed on the NUMBER touch key indicates the data number of the highlighted data in the list.

Display format menu



Jumping to the top data

6. Press the TOP touch key. "1" will be displayed on the NUMBER touch key. In the case of time stamp mode, the first measured value of the measurement block will be displayed at the top of the list.
   In the case of hardware histogram mode, the smallest value (representative value) inside the window will be displayed at the top of the list.

Jumping to the bottom data

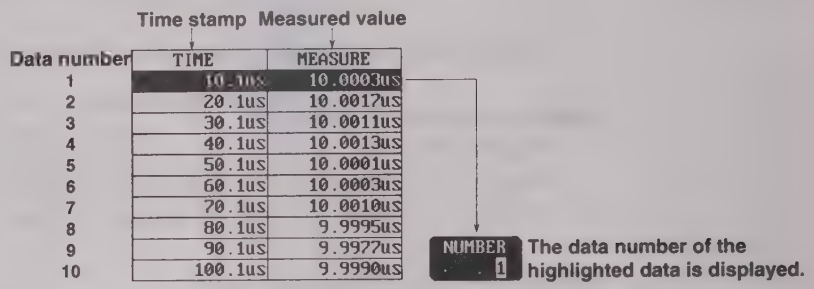
7. Press the BOTTOM touch key. In the case of time stamp mode, the last measured value of the measurement block will be displayed at the bottom of the list. The value displayed on the NUMBER touch key indicates the data number of the last measured value.
   In the case of hardware histogram mode, the largest value (class value) inside the window will be displayed at the bottom of the list. The value displayed on the NUMBER touch key indicates the data number of the largest value (class value).

Explanation

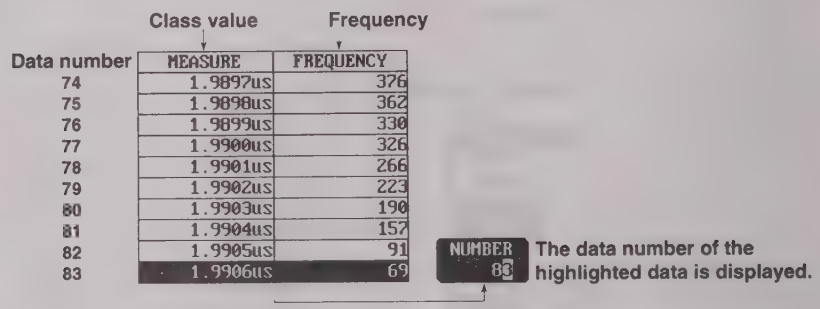
Selecting the list display function.

The list contains 10 data items. The contents of the list vary according to the selected sampling mode. The time stamp resolution is 100 ns.

- **Time stamp mode**



- **Hardware histogram mode**



Setting range for data number

The setting range varies according to the selected according to the selected sampling mode.

- Time stamp mode: From the first measured value (NUMBER 1) to the last measured value of a measurement block.
- Hardware histogram mode: From the smallest measured value (class value) (NUMBER 1) to the largest value (class value) within the window

Note

The cursor is located at data number 1 during measurement. It is not possible to set data number during measurement.

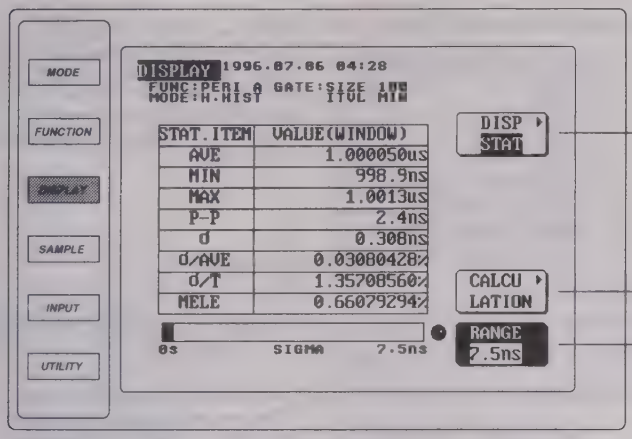
7.7 Selecting the Statistics Display Function and Reading the Statistic Data

≡For a description of the function, refer to 1.4 and 1.6≡

Procedure

- To exit from the current menu, press any of the top menu keys or press the ESC touch key displayed on the screen.

DISPLAY Top Menu



Displays the display format menu.

Displays the calculation menu.

Range touch key.
(displayed for hardware histogram mode only)

1. Press the DISPLAY key to display the DISPLAY top menu.

Selecting the statistics display function

2. Press the DISP touch key to display the display format menu.
3. Press the STATISTICS touch key to the statistics display function.
   The screen will return to the DISPLAY top menu when the STATISTICS touch key is pressed.

Setting constant T (required for hardware histogram mode only)

4. Press the CALCULATION touch key to display the calculation menu.
5. Turn the rotary knob or use the ten-key to set the desired constant T.
6. Press the ESC touch key to return to the DISPLAY top menu.

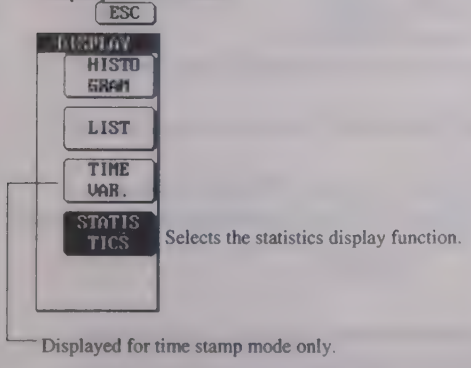
Selecting the polarity to be used for display/statistical computation (Required only if ⊣⊢ has been selected for pulse width measurement)

7. Press the POLARITY touch key to highlight ⊣⊔, ⊓⊢ or ⊣⊢. The highlighted polarity will be selected.

Selecting the bar graph range (required for hardware histogram mode only)

8. Turn the rotary knob to select the desired bar graph range.

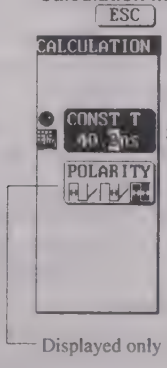
Display format menu



Selects the statistics display function.

Displayed for time stamp mode only.

Calculation menu



Sets the constant T.

Selects the polarity to be used for display/statistical computation.

Displayed only when ⊣⊢ is selected for pulse width measurement.

Explanation

Displaying the statistic values

The window displaying a histogram or the area enclosed by the markers can be set as the area to be used for statistical computation. For details, refer to 7.1.

- **Time stamp mode**
  - No computation is carried out for jitter 1 (σ/T) and jitter 2 (MELE), so asterisks "*" will be displayed.

Statistical computation item **Statistic value** **Statistical computation area**
(The entire window is used for statistical computation in this example. "MARKER" will be displayed if the area enclosed by the markers is used for statistical computation.)

STAT.ITEM	VALUE(WINDOW)
AVE	1.0001526us
MIN	999.0ns
MAX	1.0014us
P-P	2.4ns
σ	0.3900ns
σ/AVE	0.03900250%
σ/T	**********
MELE	**********

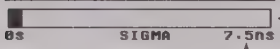
No computation is carried out for jitter 1 and jitter 2.

- **Hardware histogram mode**

A bar graph indicating the standard deviation s is displayed below the list. The bar graph range (maximum value) can be selected (see below).

Statistical computation item **Statistic value** **Statistical computation area**
(The area enclosed by the markers is used for statistical computation in this example. "WINDOW" will be displayed if the entire window is used for statistical computation.)

STAT.ITEM	VALUE(MARKER)
AVE	1.0001490us
MIN	999.1ns
MAX	1.0012us
P-P	2.1ns
σ	0.3983ns
σ/AVE	0.03982700%
σ/T	3.98329594%
MELE	0.50935654%



← Standard deviation σ is displayed in bar graph.

Bar graph range (maximum value)

Note

Statistic values are obtained as a result of computation of data present inside the window or the area enclosed by the markers. Asterisks "*" will be displayed instead of static values if no histogram exists inside the window or the area enclosed by the markers.

Setting constant T

Constant T is used for computation of jitter 1 and jitter 2 in the case of hardware histogram mode.
Setting range: 10 to 999.9 ns

Note

The same constant T is used for both histogram display function (see 7.1) and this statistics display function. In addition, it is also used for pulse width measurement (see 5.4).

- **Selecting the polarity to be used for display/statistical computation**

The same menu as the one displayed when ⊣↔⊢ is selected as the polarity for pulse width measurement is displayed. (It is also the same menu as the calculation menu displayed in 7.1). Select the desired polarity from the following to be used for statistical computation.

- ⊣↔⌋: Performs statistical computation for the positive side only.
- ⌈↔⊢: Performs statistical computation for the negative side only.
- ⊣↔⊢: Performs statistical computation for the both positive and negative sides. However, computation results will be as follows.
  - Maximum, minimum, average, peak to peak, flutter, jitter 2: Not computed and asterisks "*" are displayed instead of the statistic values.
  - Standard deviation, jitter 1: Standard deviation (σ) and jitter 1 (σ/T) are computed, individually for positive and negative sides, then the sum of computed standard deviation and that of computed jitter 1 are divided by 2.

Selecting the bar graph range

The standard deviation (σ) is displayed in a bar graph only when the statistic display function is ON in hardware histogram mode. The maximum bar graph range can be selected from the following.
7.5/15/30/60 ns

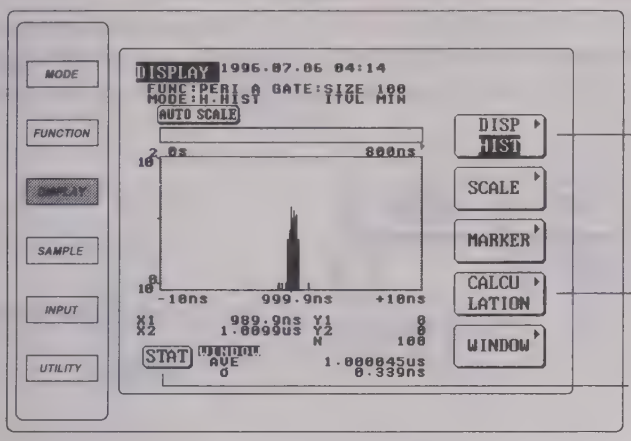
7.8 Selecting the Histogram Display Function and Displaying the Statistic Data

Procedure

≡For a description of the function, refer to 1.4 and 1.6≡

- To exit from the current menu, press any of the top menu keys or press the ESC touch key displayed on the screen.

DISPLAY Top Menu



1. Press the DISPLAY key to display the DISPLAY top menu.

Selecting the statistics display function

2. Select the statistics display function as described in 7.1.

Selecting the statistical computation items

3. Press the STAT touch key located at the bottom of the screen to display the statistical computation item menu.
4. Press the touch keys corresponding to the desired items. The selected items will be displayed on the right of the STAT touch key. Only two items can be selected at a time. If the STAT touch key is pressed again to select other items, the previously selected and displayed two items will be replaced by newly selected items.

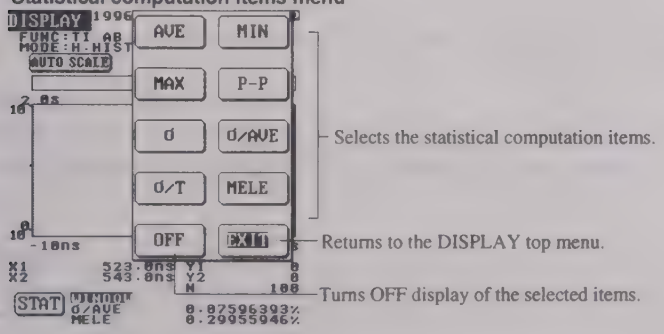
Turning OFF display of the selected items

5. Press the OFF touch menu of the statistical computation item menu. The currently displayed two items will disappear.

Returning to the DISPLAY top menu

6. Press the STAT touch key again or press the EXIT touch key to return to the DISPLAY top menu.

Statistical computation items menu



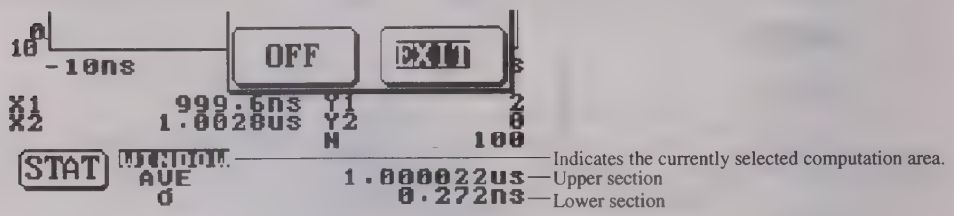
Explanation

Statistical computation items

The same statistical computation items as for 7.7 are available. Thus, no computation will be carried out for jitter 1 (σ/T) and jitter 2 (MELE) and therefore asterisks "*" are displayed, even if they are selected.

Allowable number of items selected

Up to two items can be displayed. If a third item is selected by pressing the corresponding touch key, the first item (displayed at the upper section of the statistic data area) will disappear, the second item will move up, and the newly selected item will be displayed at the lower section.



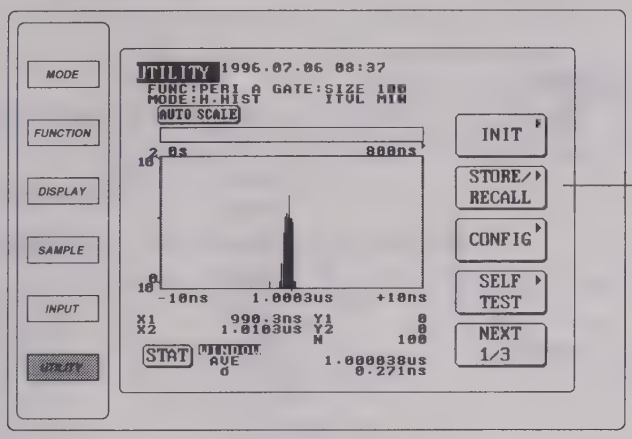
8.1 Storing the Set-up Information in the Internal Memory

≡For a description of the function, refer to 1.7≡

Procedure

- To exit from the current menu, press any of the top menu keys or press the ESC touch key displayed on the screen.

UTILITY Top Menu



1. Press the UTILITY key to display the UTILITY top menu.
2. Press the STORE/RECALL touch key to display the store/recall menu.

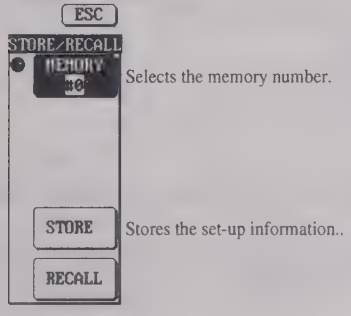
Selecting the memory number

3. Turn the rotary knob to select the desired memory number.

Storing the set-up information

4. Press the STORE touch key to store the set-up information into the selected memory.

Store/recall menu



Explanation

Set-up information to be stored

Settings made and selected using touch keys, rotary knob and ten-key are stored.

Selecting the memory number

Select the desired memory number from the following 10 numbers. If set-up information already exists in the selected memory, it will be overwritten by the new set-up information.

#0 to #9

Note

The stored set-up information will not be deleted even if initialization is carried out.

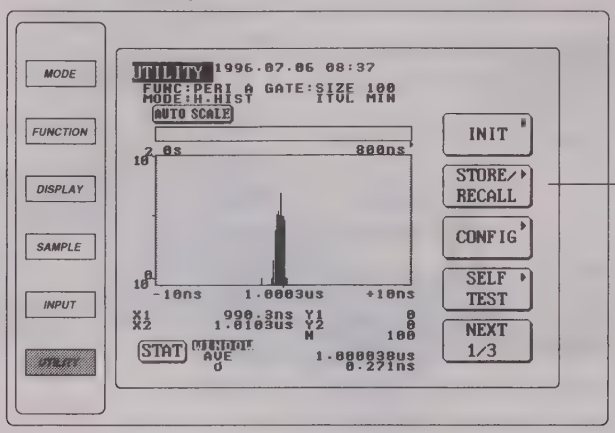
8.2 Recalling the Set-up Information from the Internal Memory

Procedure

≡For a description of the function, refer to 1.7≡

- To exit from the current menu, press any of the top menu keys or press the ESC touch key displayed on the screen.

UTILITY Top Menu



1. Press the UTILITY key to display the UTILITY top menu.
2. Press the STORE/RECALL touch key to display the store/recall menu.

Selecting the memory number

3. Turn the rotary knob to select the desired memory number.

Recalling the set-up information

4. Press the RECALL touch key to recall the set-up information from the selected memory.

Store/recall menu

Selects the memory number.

Recalls the set-up information.

Explanation

Set-up information to be recalled

The set-up information stored in the desired memory is recalled. The current set-up information of the instrument will be replaced by the recalled one.

Selecting the memory number

Select the desired memory number from the following 10 numbers. Only the memory numbers where set-up information exists can be selected.

#0 to #9

9.1 Points to Note during Use of the Floppy Disk Drive

Applicable Floppy Disks

The following type of 3.5-inch floppy disk can be used. Floppy disks can be formatted using this instrument.

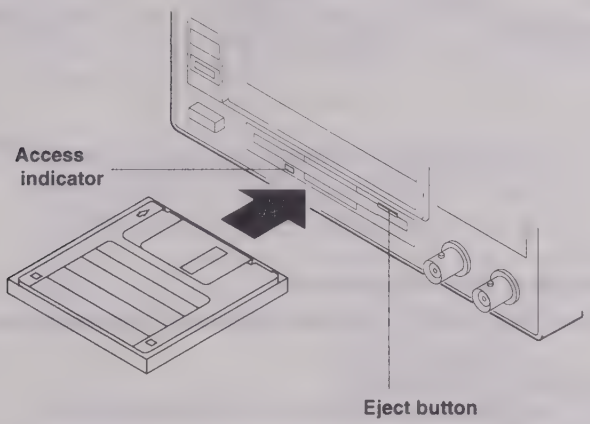
- 2HD type : 1.2 MB or 1.44 MB (MS-DOS format)
- 2DD type : 640 KB or 720 KB (MS-DOS format)

Inserting a Floppy Disk into the Floppy Disk Drive

Place the floppy disk with the label facing upward and insert it into the floppy disk drive. Insert it until the eject button pops up.

Removing the Floppy Disk from the Floppy Disk Drive

Make sure that the access indicator is OFF, then press the eject button to remove the floppy disk.



CAUTION

Never remove the floppy disk while the access indicator is blinking. Failure to do so may damage the magnetic head of the floppy disk drive or destroy the data saved on the floppy disk.

General Points to Note during Use of the Floppy Disk

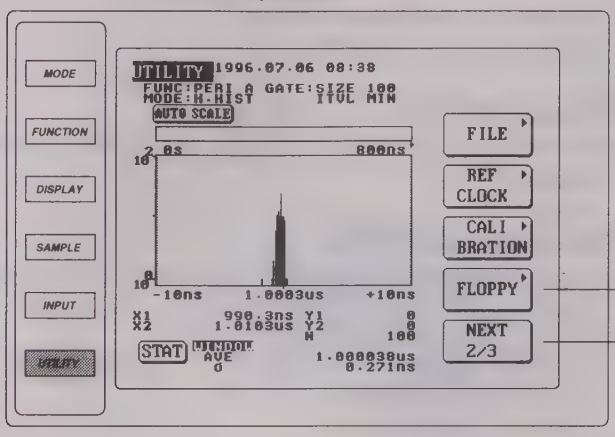
For general precautions regarding use of the floppy disk, refer to the instruction sheets supplied with the floppy disk.

9.2 Formatting a Floppy Disk

Procedure

- To exit from the current menu, press any of the top menu keys or press the ESC touch key displayed on the screen.

UTILITY Top Menu



1. Insert a floppy disk to be formatted into the floppy disk drive.
2. Press the UTILITY key to display the UTILITY top menu.
3. Press the NEXT touch key to display NEXT 2/3 on the key.

Displaying the floppy disk menu

4. Press the FLOPPY touch key to display the floppy disk menu.

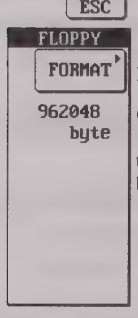
Selecting the format type

5. Press the FORMAT touch key to display the format menu.
6. Press the touch key corresponding to the desired format type.

Formatting the floppy disk

7. Press the EXEC touch key to format the floppy disk.

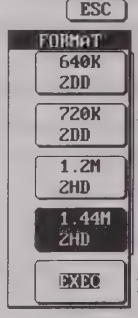
Floppy menu



Displays the format menu.

(Free space available on the floppy disk is displayed if the floppy disk has already been formatted.)

Format menu



Selects the format type.

Performs formatting.

Explanation

Displaying the free space available on the floppy disk

If the floppy disk menu is displayed with a MS-DOS formatted floppy disk inserted into the floppy disk unit, the free space available on the floppy disk will be displayed.

Selecting the format type

Select the desired format type from the following.

- 640K2DD: Used to format a 2DD type floppy disk for 640 KB/8 sectors.
- 720K2DD: Used to format a 2DD type floppy disk for 720 KB/9 sectors.
- 1.2M2HD: Used to format a 2HD type floppy disk for 1.2 MB/8 sectors.
- 1.44M2HD: Used to format a 2HD type floppy disk for 1.44 MB/18 sectors.

Creating directories during formatting

The following directories will be created on the floppy disk automatically when the floppy disk is formatted.

- TA_WAVE: Directory for measured binary data (BIN)
- TA_SETUP: Directory for set-up information
- TA_TEXT: Directory for measured text data (TEXT)
- TA_MISC: Directory for screen image data including set-up information (IMAGE)/statistical computation text data (STAT)

Note

- Floppy disks formatted in a format type other than those specified above cannot be used with this instrument.
- If an error message is displayed after formatting, the floppy disk may be faulty.
- All the data stored on the floppy disk will be deleted when the floppy disk is formatted.

CAUTION

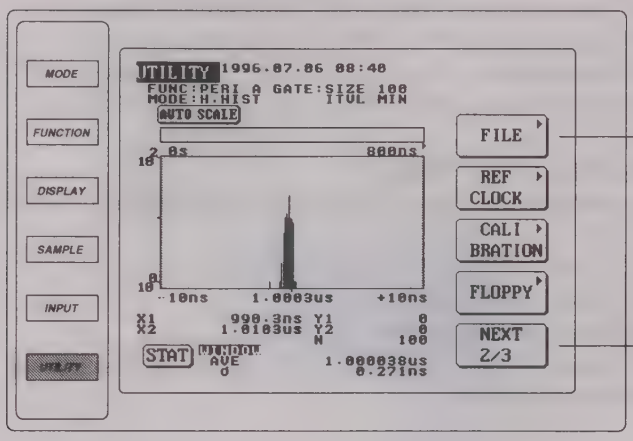
Never remove the floppy disk while the access indicator is blinking. Failure to do so may damage the magnetic head of the floppy disk drive or destroy the data saved on the floppy disk.

9.3 Saving, Loading and Auto Loading the Set-up Information

Procedure

- To exit from the current menu, press any of the top menu keys or press the ESC touch key displayed on the screen.

UTILITY Top Menu



1. Insert a formatted floppy disk into the floppy disk drive.
2. Press the UTILITY key to display the UTILITY top menu.
3. Press the NEXT touch key to display NEXT 2/3 on the key.

Saving the set-up information

4. Press the FILE touch key to display the file menu.

- **Selecting the item to be saved**

5. Turn the rotary knob to highlight ITEM SETUP on the ITEM touch key to select the set-up information.

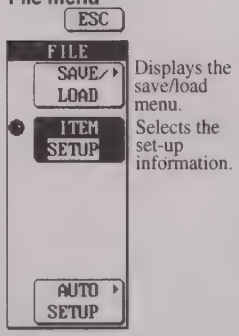
- **Setting the file name**

6. Press the SAVE/LOAD touch key to display the save/load menu.
7. Press the SAVE touch key to display the save menu. A keyboard will be displayed.
8. Enter the desired file name using the keyboard. The file name will be displayed on the upper left corner of the keyboard.
9. To correct the file name, press the < arrow key. Each time the < arrow key is pressed, the cursor moves to the left one character, thus the characters of the file name are deleted one by one.

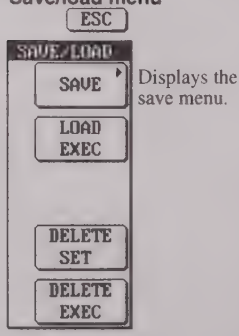
- **Performing saving**

10. After the file name is set, press the SAVE EXEC touch key to save the set-up information.

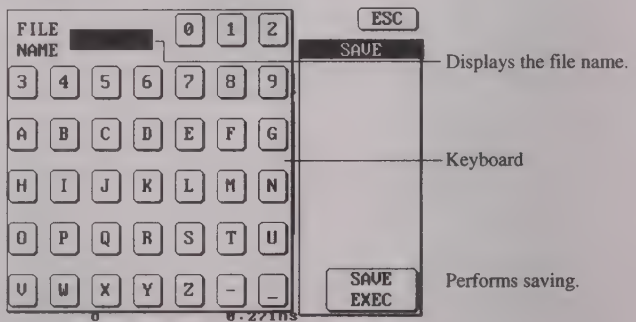
File menu



Save/load menu

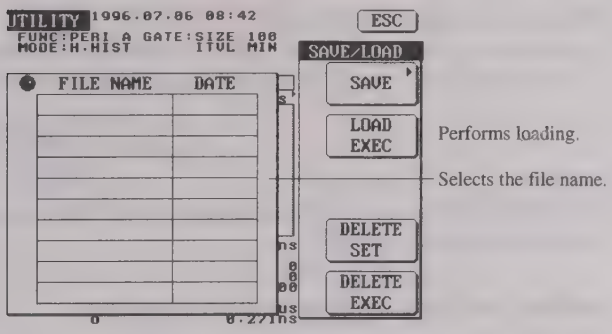


Save menu



Loading the setup information

11. After step 6, turn the rotary knob to select the file name to be loaded.
12. Press the LOAD EXEC touch key.



Loading the setup information automatically

- **Saving the setup information to be loaded automatically**

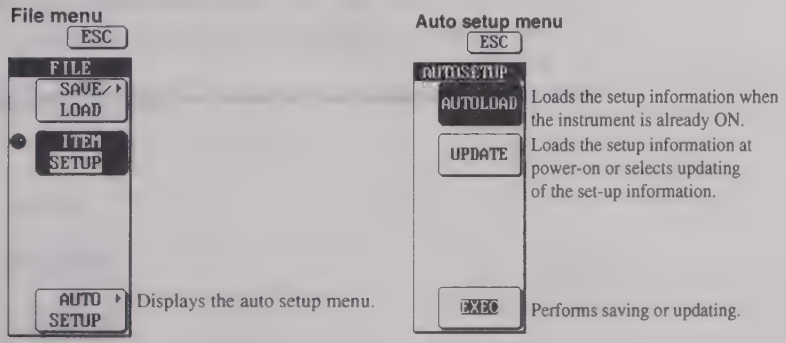
13. After step 4, press the AUTO SETUP touch key to display the auto setup menu.
14. Press the UPDATE touch key to highlight UPDATE.
15. Press the EXEC touch key to save the set-up information into the auto load file (i.e. the file from which the set-up information is to be loaded automatically). If set-up information already exists in the file, it will be updated.

- **Loading the setup information automatically**

16. Before turning ON the power switch of the instrument, insert the floppy disk containing the auto load file into the floppy disk drive.
17. Turn ON the power switch. An access will be made to the floppy disk automatically, and the set-up information saved in the auto load file will be loaded to the instrument.

- **Loading the setup information when the instrument is already ON**

18. After step 13, press the AUTOLOAD touch key to highlight AUTOLOAD.
19. Press the EXEC touch key to load the set-up information from the auto load file.



Explanation

Set-up information to be saved

Settings made and selected using touch keys, rotary knob and ten-key are saved. In addition, the set-up information stored in the internal memory is also saved in the auto load file.

File name extension and directory

An extension (.SET) is attached to the file name automatically, and the file is saved in the directory TA_SETUP. The auto load file is called AUTOLOAD.SET and saved in the root directory.

Data size

Each set-up information requires approximately 8 KB. The auto load file can contain data of approximately 50 KB in total.

Checking the free space available on a floppy disk

Refer to 9.2.

Entering the file name

- The file name must consist of 8 or less characters.
- The following characters can be used for file name.
  Alphabets (capital letter), numerical values, – (minus), _ (under-bar)
- The following file names cannot be used due to restrictions on MS-DOS.
  AUX, CON, PRN, NUL, CLOCK
- Saving under a file name already existing in the same directory is not allowed. (Overwriting is not allowed.)

Note

- Loading is not possible during measurement (i.e. while the START indicator is ON).
- If the extension of a file name is changed using a personal computer etc., it will be impossible to load that file.

CAUTION

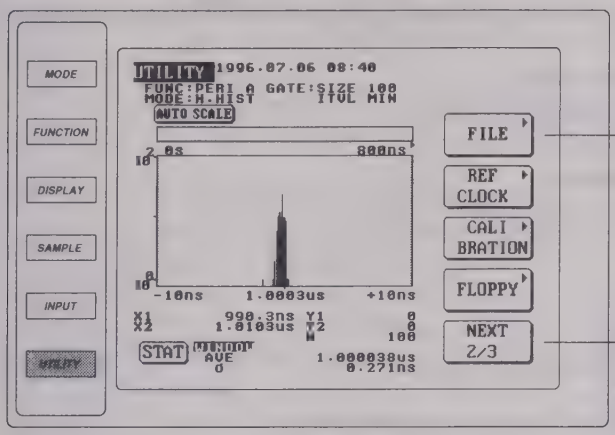
Never remove the floppy disk while the access indicator is blinking. Failure to do so may damage the magnetic head of the floppy disk drive or destroy the data saved on the floppy disk.

9.4 Saving and Loading the Measured and Computed Data

Procedure

- To exit from the current menu, press any of the top menu keys or press the ESC touch key displayed on the screen.

UTILITY Top Menu



1. Insert a formatted floppy disk into the floppy disk drive.
2. Press the UTILITY key to display the UTILITY top menu.
3. Press the NEXT touch key to display NEXT 2/3 on the key.

Saving the measurement results

4. Press the FILE touch key to display the file menu.

- **Selecting the item to be saved**

5. Turn the rotary knob to highlight ITEM MEASDATA on the ITEM touch key. The DATATYPE touch key will appear.
6. Press the DATATYPE touch key to highlight TEXT or BIN on the key. The highlighted data type will be selected.

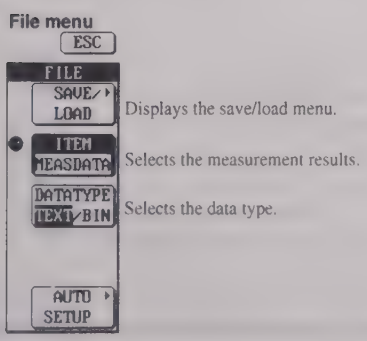
- **Setting the file name**

7. Refer to "Setting the file name" in 9.3.

- **Performing saving**

8. Refer to "Performing saving" in 9.3.

File menu



Loading the measurement results

9. After step 6, press the SAVE/LOAD touch key to display the save/load menu.
10. Refer to "Loading the setup information" in 9.3.

Saving the statistical computation results

- **Selecting the item to be saved**

11. After step 4, turn the rotary knob to highlight ITEM STAT on the ITEM touch key.

- **Setting the file name**

12. Refer to "Setting the file name" in 9.3.

- **Performing saving**

13. Refer to "Performing saving" in 9.3.

File menu

Displays the save/load menu.

Selects the statistical computation results.

Explanation

Saving the measurement results

- **Selecting the data type**

  Select the desired data type from the following.

  - BIN: The measurement results are saved in binary format. Once they are saved, they can be loaded to the instrument.
  - TEXT:
    - Hardware histogram mode: Values (representative values) in the histogram window and their frequency are saved in text format. They cannot be loaded to the instrument after they are saved.
    - Time stamp mode: All the data (time stamps and measured values) of a measurement block are saved in text format. They cannot be loaded to the instrument after they are saved.

- **File name extension and directory**

  File name extension and directory vary depending on the data type. An appropriate extension is attached to the file name before the file is saved in its corresponding directory.

  - BIN: ".WVF" is attached to the file name, and the file is saved in the directory TA_WAVE. The header file (ASCII format) is also saved at the same time. The header file contains the information to be used for analysis of the saved data. The extension for the header file is ".HDR".
  - TEXT: ".CSV" is attached to the file name, and the file is saved in the directory TA_TEXT.

- **Data size**

  The data size varies depending on the number of samples (S) and data type. (Unit: bytes)

  - BIN:
    - Measured data obtained in hardware histogram mode: Approx. 133 K bytes (approx. 384 K bytes for simultaneous positive/negative measurement of pulse width measurement)
    - Measured data obtained in time stamp mode: Approx. 8 bytes × S + approx. 8 K bytes
  - TEXT: The data size varies considerably depending on the selected sampling mode, sample size and histogram display etc. However, the maximum data size is approx. 1 M bytes.

Saving the statistical computation results

- **File name extension and directory**

  ".CSV" is attached to the file name, and the file is saved in the directory TA_MISC.

- **Data size**

  Each computation data requires approx. 500 bytes.

Checking the free space available on a floppy disk

Refer to 9.2.

Entering the file name

Refer to 9.3.

Note

- Loading and saving are not possible during measurement (i.e. while the START indicator is ON).
- Loading of measurement results (text format) and statistical computation results to this instrument is not possible.
- If measurement results are loaded, the set-up information accompanying the loaded measurement results will be used as the set-up information.
- If the extension of a file name is changed using a personal computer etc., it will be impossible to load that file.

CAUTION

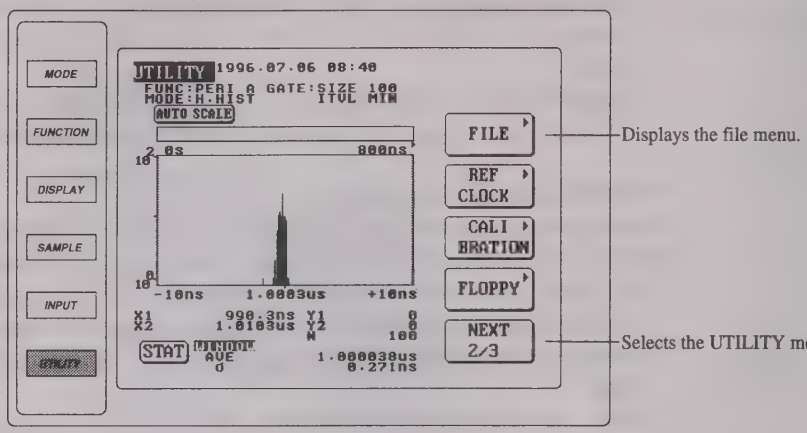
Never remove the floppy disk while the access indicator is blinking. Failure to do so may damage the magnetic head of the floppy disk drive or destroy the data saved on the floppy disk.

9.5 Saving the Screen Image Data

Procedure

- To exit from the current menu, press any of the top menu keys or press the ESC touch key displayed on the screen.

UTILITY Top Menu



1. Insert a formatted floppy disk into the floppy disk drive.
2. Press the UTILITY key to display the UTILITY top menu.
3. Press the NEXT touch key to display NEXT 2/3 on the key.

Saving the screen image data

4. Press the FILE touch key to display the file menu.

- **Selecting the item to be saved**

5. Turn the rotary knob to highlight ITEM IMAGE on the ITEM touch key, to select the screen image data.

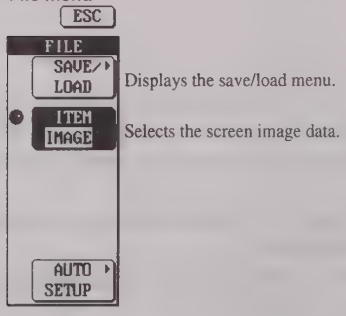
- **Setting the file name**

6. Refer to "Setting the file name" in 9.3.

- **Performing saving**

7. Refer to "Performing saving" in 9.3.

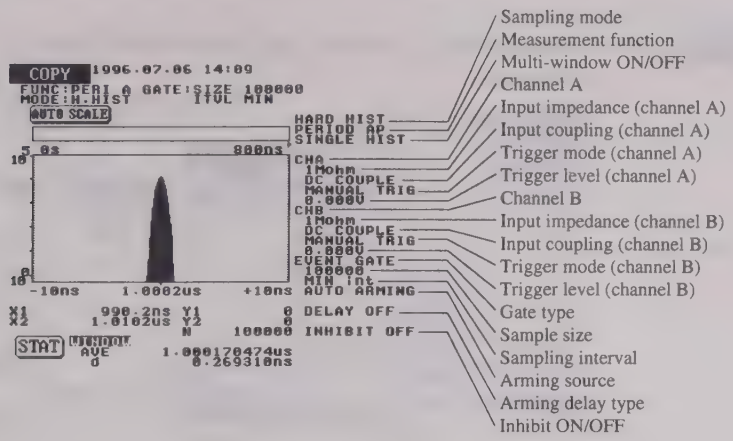
File menu



Explanation

Saving the screen image data

The screen image data will be saved in TIFF format.



File name extension and directory

".TIF" is attached to the file name, and the file is saved in the directory TA_MISC.

Data size

Each screen image data requires approx. 11 K bytes.

Checking the free space available on a floppy disk

Refer to 9.2.

Entering the file name

Refer to 9.3.

Note

- Saving is not possible during measurement (i.e. while the START indicator is ON).
- Loading of the screen image data to this instrument is not possible.

CAUTION

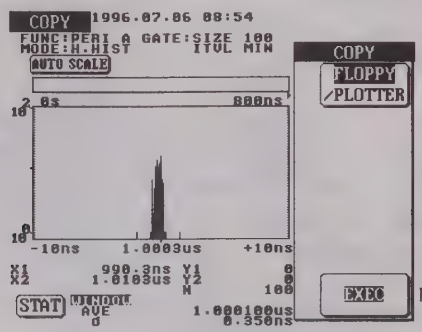
Never remove the floppy disk while the access indicator is blinking. Failure to do so may damage the magnetic head of the floppy disk drive or destroy the data saved on the floppy disk.

9.6 Auto Saving the Screen Image Data

Procedure

- To exit from the current menu, press any of the top menu keys.

COPY menu



Selects the copy destination (floppy).

Performs copying.

1. Insert a formatted floppy disk into the floppy disk drive.

Selecting the floppy disk as copy destination.

2. Press the COPY key to display the COPY menu.
3. Press the FLOPPY/PLOTTER touch key to highlight FLOPPY.

Performing copying

4. Press the EXEC touch key.

Explanation

Saving the screen image data automatically

The screen image data will be saved in TIFF format. For items to be saved, refer to 9.5.

File name

A file name is assigned to each screen image data automatically, starting with TA000 up to TA1000 sequentially. When TA1000 is reached, auto saving will be disabled.

File name extension, directory, data size and checking the free space available on a floppy disk

Refer to 9.5.

Note

- Saving is not possible during measurement (i.e. while the START indicator is ON).
- Loading of the screen image data to this instrument is not possible.

CAUTION

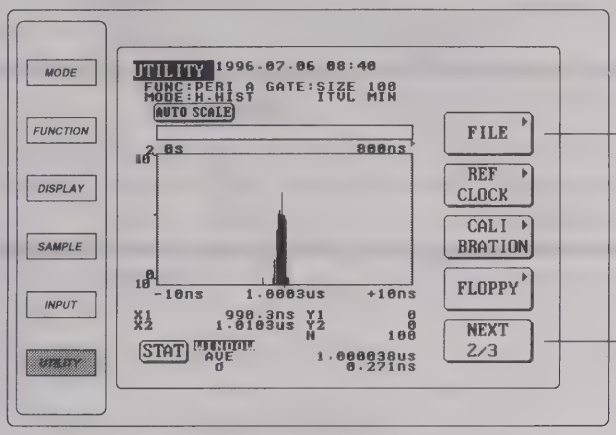
Never remove the floppy disk while the access indicator is blinking. Failure to do so may damage the magnetic head of the floppy disk drive or destroy the data saved on the floppy disk.

9.7 Deleting Saved Data

Procedure

- To exit from the current menu, press any of the top menu keys or press the ESC touch key displayed on the screen.

UTILITY Top Menu



1. Insert a formatted floppy disk into the floppy disk drive.
2. Press the UTILITY key to display the UTILITY top menu.
3. Press the NEXT touch key to display NEXT 2/3 on the key.

Selecting the item to be deleted

4. Press the FILE touch key to display the file menu.
5. Turn the rotary knob to highlight the desired item on the ITEM touch key. The highlighted item to be deleted will be selected.

Selecting the name of the file to be deleted

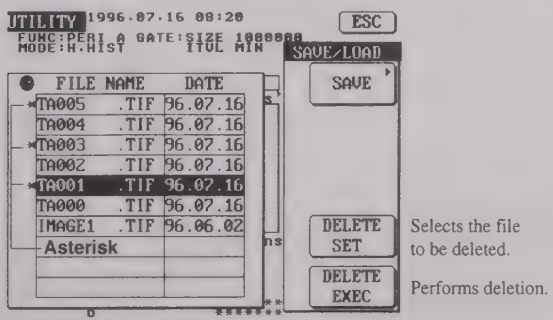
6. Press the SAVE/LOAD touch key to display the save/load menu.
7. Turn the rotary knob to highlight the file to be deleted.
8. Press the DELETE SET touch key. An asterisk " * " will be displayed on the left of the selected file name, indicating the file to be deleted has been selected. Pressing the DELETE SET touch key again causes the asterisk to disappear, indicating that selection of the file has been canceled.

Performing deletion

9. After the file to be deleted has been selected, press the DELETE EXEC touch key to delete the file.

File menu

Save/load menu



Explanation

To delete data (file), select the file type (item) according to steps 4 and 5, then select the name of the file to be deleted.

Note

Once data is deleted, it will not be possible to recover the data again. So take special care not to delete the wrong file by mistake.

CAUTION

Never remove the floppy disk while the access indicator is blinking. Failure to do so may damage the magnetic head of the floppy disk drive or destroy the data saved on the floppy disk.

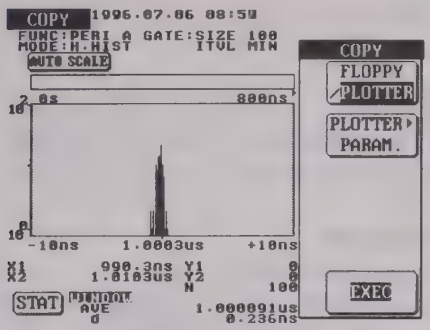
10.1 Outputting Data to a Plotter

Procedure

≡For a description of the function, refer to 1.7≡

- To exit from the current menu, press any of the top menu keys.

COPY menu



Selects the plotter.

Displays the plotter parameter menu.

Performs output to the plotter.

1. Connect the plotter to the instrument. For details, refer to "Explanation" in this section.

Setting the plotter as destination

2. Press the COPY key to display the COPY menu.
3. Press the FLOPPY/PLOTTER touch key to highlight PLOTTER. The PLOTTER PARAM. touch key will be displayed.

Setting the plotter parameters

4. Press the PLOTTER PARAM. touch key to display the plotter parameter menu.

- **Selecting the paper size**

5. Press the PAPER touch size to highlight PAPER.
6. Turn the rotary knob to select the desired paper size.

- **Selecting the pen speed**

7. Press the SPEED touch key to highlight NORM or LOW. The highlighted speed will be selected.

- **Selecting the pen mode**

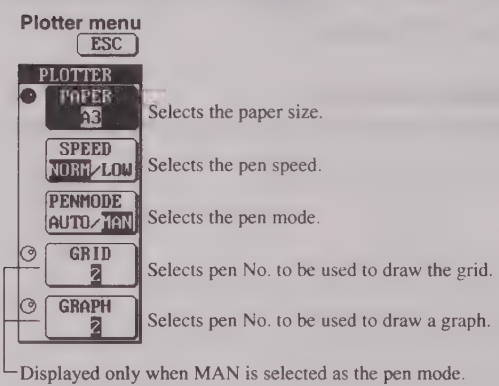
8. Press the PENMODE touch key to highlight AUTO or MAN. The highlighted mode will be selected. If AUTO is selected, proceed to step 13, or if MAN is selected, proceed to step 9.

- **Selecting pen assignment**

9. Press the GRID touch key to highlight GRID.
10. Turn the rotary knob to select the pen No. to be used to draw the grid.
11. Press the GRAPH touch key to highlight GRAPH.
12. Turn the rotary knob to select the pen No. to be used to draw a graph.

- **Returning to the COPY menu**

13. Press the ESC touch key.



Performing output to the plotter

14. Press the EXEC touch key to output the screen image data to the plotter.

Explanation

Connecting the plotter

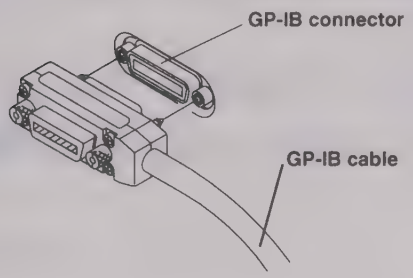
- **Applicable plotters**

  HP-GL compatible plotters (i.e. plotters which support the HP-GL commands) can be used with this instrument. Drawable range may differ depending on the plotter model, causing incomplete plotting.

  HP-GL compatible plotter (by YOKOGAWA): PL600 high-speed color plotter (model: 700983)

- **Connecting the plotter**

  1. Check that the power to both plotter and this instrument is OFF.
  2. Connect the plotter to the instrument using the GP-IB cable. Tighten the screws to secure the connector firmly.



- **Setting the communication parameters**
  - This instrument: When the EXEC touch key is pressed to send the screen image data to the plotter, the instrument will be switched to talk-only mode automatically. It is not possible to switch the instrument to talk-only mode using front panel keys.
  - Plotter: Switch the plotter to listen-only mode.

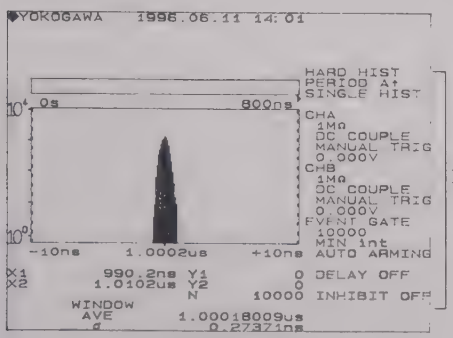
Note

- Outputting to the plotter is not possible during measurement.
- For a description of the GP-IB interface, refer to the GP-IB Interface User's Manual (IM704210-12E),

Selecting the paper size

The following paper sizes are available. Select the desired paper size.

Selected Paper Size	Output Size	Output Position
A3	A3	Center
A4	A4	Center
A5 Upper	A5	Upper half (A4)
A5 Lower	A5	Lower half (A4)



For details, refer to 9.5.

Selecting the pen speed

Select the desired pen speed from the following.

- NORM: Draws the screen image at the plotter's default speed.
- SLOW: Draws the screen image at 10 cm/s.

Selecting pen assignment

Select the desired pen assignment from the following.

- AUTO: Assigns pens automatically according to the number of pens available with the plotter.

Number of Pens	GRID*1	GRAPH*2
1	1	1
2	1	2

- MAN: Allows the user to assign a pen to GRID *1 and GRAPH *2. Pen Nos. 1 to 12 can be selected.

*1: Used for any drawings other than graph (e.g. characters, numerical values, graph's frame, grid)

*2: Used to draw bins (for histogram display) and broken lines (for time variation display).

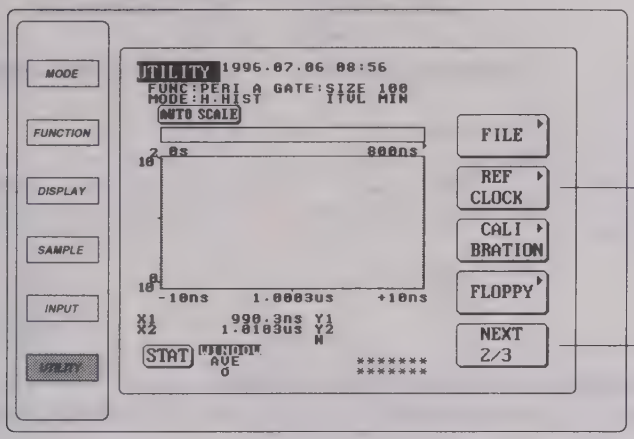
10.2 Inputting and Outputting the Reference Signal

Procedure

≡For a description of the function, refer to 1.7≡

- To exit from the current menu, press any of the top menu keys or press the ESC touch key displayed on the screen.

UTILITY Top Menu



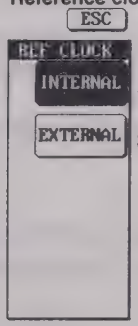
Connecting a BNC cable

1. Connect a BNC cable to the reference input terminal (REFERENCE IN) and reference output terminal (REFERENCE OUT).

Selecting the reference clock

2. Press the UTILITY key to display the UTILITY top menu.
3. Press the NEXT touch key to display NEXT 2/3 on the key.
4. Press the REF CLOCK touch key to display the reference clock menu.
5. Press the INTERNAL or EXTERNAL touch key. The highlighted reference clock will be selected.

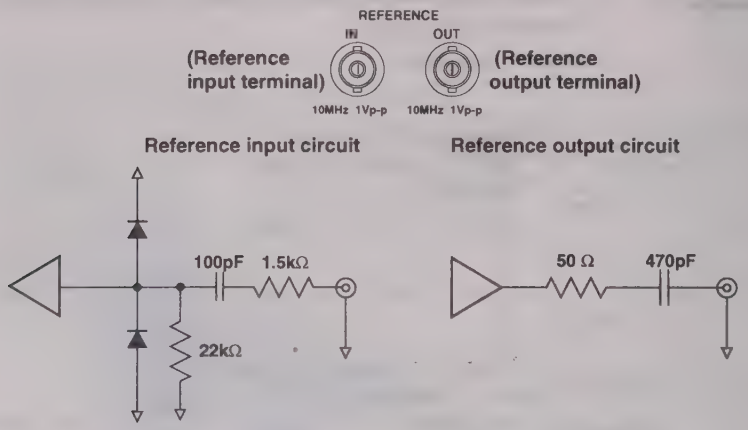
Reference clock menu



Explanation

Connecting a BNC cable

Connect a BNC cable to the reference input terminal (REFERENCE IN) and reference output terminal (REFERENCE OUT) provided on the rear panel of the instrument.



- **nputting the external reference clock signal**

  Input the external reference clock signal to the reference input terminal (REFERENCE IN).
  - Input frequency range: 10 MHz ±10 Hz
  - Input impedance: 1 kΩ min.
  - Input coupling: AC
  - Input voltage level: 1 V_{p-p} min.
  - Maximum input voltage: ±10 V

CAUTION

Never apply a voltage exceeding the maximum input voltage to the reference input terminal. Damage to the input terminals may result.

- **Outputting the reference clock signal**

  The reference clock signal is output from the reference output terminal. The reference clock selected, as described in "Selecting the reference clock" at the foot of this page, will be output all the time.
  - Output frequency: 10 MHz (Typical *)
  - Output impedance: 50 Ω (Typical *)
  - Output coupling: AC
  - Output voltage level: 1 V_{p-p} min. when the output is received by input impedance of 50 Ω

  * Typical value is described in terms of typical of average performance. However, they cannot be guaranteed.

CAUTION

Never short-circuit the reference output terminal or apply an external voltage to it. Damage to the internal circuits may result.

Selecting the reference clock

Select the desired reference clock from the following.
- INTERNAL: Selects the internal reference clock signal.
- EXTERNAL: Selects the external reference clock signal.

10.3 Outputting the Monitor Signal

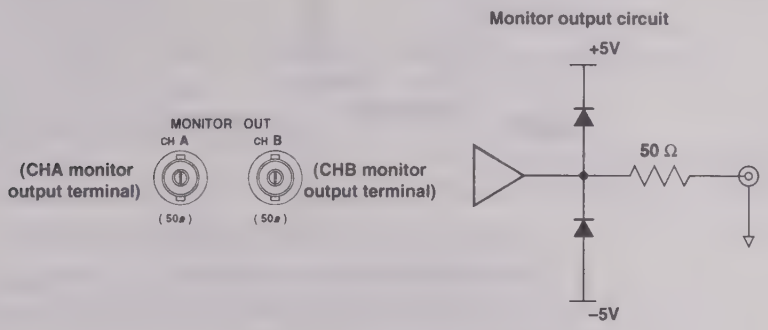
≡For a description of the function, refer to 1.7≡

Connecting a BNC cable

Connect a BNC cable to the monitor output terminals (MONITOR OUT CHA/CHB) provided on the rear panel of the instrument.

Explanation

The measuring signal input to CHA is output from the MONITOR OUT CHA terminal constantly, and the measuring signal input to CHB is output from the MONITOR OUT CHA terminal constantly.



- Output impedance: 50 Ω (typical *)
- Output voltage level: Approx. 1/4 of the measuring input signal (within ±5 V) when the output is received by input impedance of 50 Ω

  * Typical value is described in terms of typical of average performance. However, they cannot be guaranteed.

CAUTION

Never short-circuit the monitor output terminals or apply an external voltage to them. Damage to the internal circuits may result.

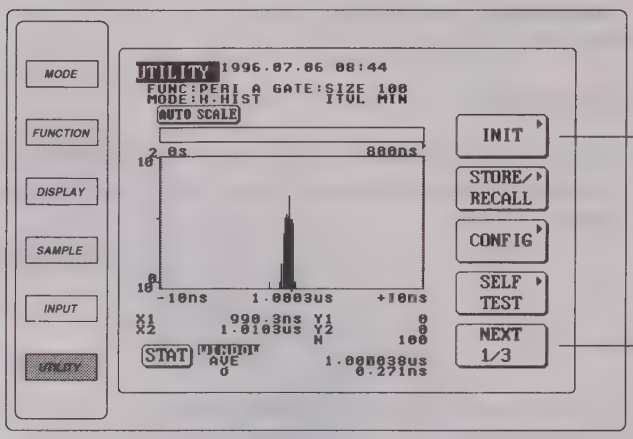
10.4 Initializing the Set-up Information

Procedure

≡For a description of the function, refer to 1.7≡

- To exit from the current menu, press any of the top menu keys.

UTILITY Top Menu



1. Press the UTILITY key to display the UTILITY top menu.
2. Press the NEXT touch key to display NEXT 1/3 on the key.
3. Press the INIT touch key to display the initialize menu.

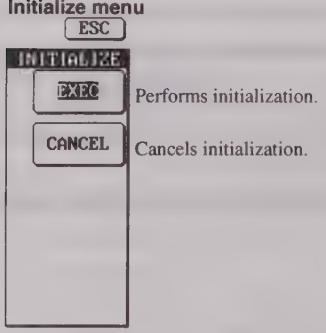
Performing initialization

4. Press the EXEC touch key.

Canceling initialization

5. After step 3, press the CANCEL touch key.

Initialize menu



Explanation

Default settings

The set-up information will be set as shown below when initialization is performed.

- Acquisition of measuring signal: START
- Measurement function: PERIOD
- Slop: ↑
- Input impedance: 1 MΩ
- Trigger level: 0.000 V
- Number of events: 100
- External gate polarity: ⎍
- Arming source: AUTO
- Arming ready: OFF
- Inhibit: OFF
- Computation area: WINDOW
- Multi-window: SINGLE
- Window size: 1
- Sampling mode: H.HIST
- Measurement channel: CHA
- Input coupling: DC
- Trigger mode: MUNUAL
- Gate type: EVENT
- Gate time: 1.000 ms
- Sampling interval: MIN
- Arming slope: ↑
- Arming delay time: 1.000 ms
- Display format: HISTOGRAM
- Constant T: 40.0 ns
- Multi-window mode: AUTO
- Reference clock: INTERNAL

Items which cannot be initialized

- Date/time
- Communication address (Factory setting: 1)
- Touch key sound (Factory setting: ON)
- Set-up information stored in the internal
- Screen contrast (Factory setting: 15)

Note

Measurement/computation will be stopped when initialization is started.

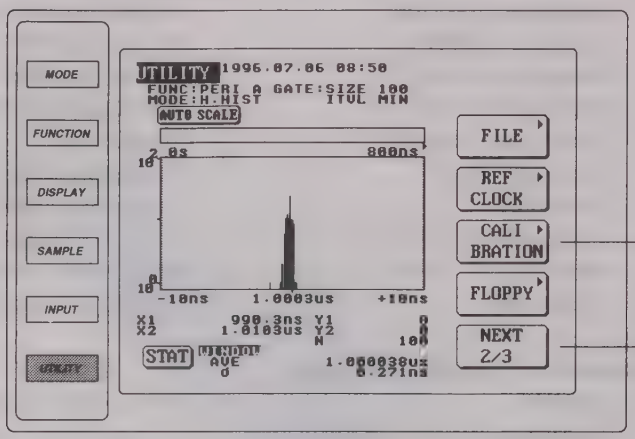
10.5 Calibrating the Instrument

Procedure

≡For a description of the function, refer to 1.7≡

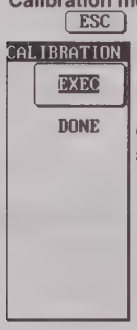
- To exit from the current menu, press any of the top menu keys.

UTILITY Top Menu



1. Press the UTILITY key to display the UTILITY top menu.
2. Press the NEXT touch key to display NEXT 2/3 on the key.
3. Press the CALIBRATION touch key to display the calibration menu.
4. Press the EXEC touch key. DONE will be displayed when calibration is complete.

Calibration menu



Performs calibration.

(Asterisk "*" is displayed during calibration, and DONE is displayed when it is completed.)

Explanation

Calibration of the offset voltage of each input amplifier and conversion factor of each T/V converter is carried out automatically using the internal calibration signal.

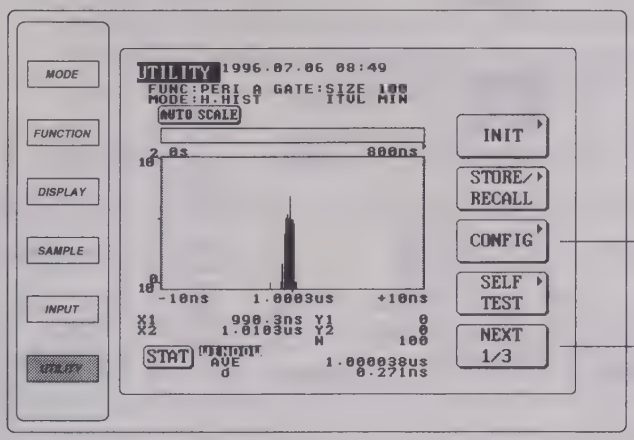
10.6 Setting the Screen Contrast

Procedure

≡For a description of the function, refer to 1.7≡

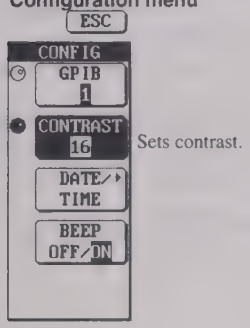
- To exit from the current menu, press any of the top menu keys.

UTILITY Top Menu



1. Press the UTILITY key to display the UTILITY top menu.
2. Press the NEXT touch key to display NEXT 1/3 on the key.
3. Press the CONFIG touch key to display the configuration menu.
4. Press the CONTRAST touch key to highlight CONTRAST.
5. Turn the rotary knob to set the desired contrast.

Configuration menu



Explanation

Contrast setting range: 0 to 30

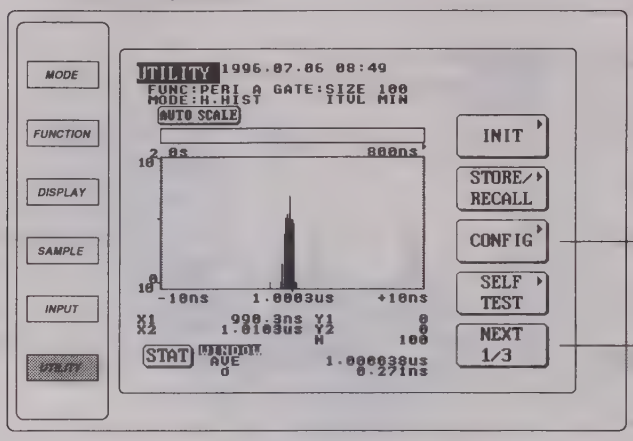
10.7 Turning the Touch-key Sound ON/OFF

Procedure

≡For a description of the function, refer to 1.7≡

- To exit from the current menu, press any of the top menu keys.

UTILITY Top Menu



Displays the configuration menu.

Selects the UTILITY menu.

1. Press the UTILITY key to display the UTILITY top menu.
2. Press the NEXT touch key to display NEXT 1/3 on the key.
3. Press the CONFIG touch key to display the configuration menu.
4. Press the BEEP touch key to highlight OFF or ON. The highlighted option will be selected.

Configuration menu

Turns the touch-key sound ON/OFF.

Explanation

Select from the following.

- OFF: Sound is not produced even if a touch key is pressed.
- ON: Sound is produced when a touch key is pressed.

11.1 Troubleshooting

- For a description of corrective actions to be taken when a message appears on the screen, refer to Section 11.2 "Messages".
- If maintenance service is required, or if the instrument still does not operate properly even after the following corrective action has been taken, contact your nearest YOKOGAWA representative, listed on the back cover of this manual.

Symptom	Possible Cause	Corrective Action	Reference Section
The power does not come ON.	The source voltage is outside the rated range.	Connect the instrument to a source of the correct voltage.	3.3
	Circuit breaker is activated.	Check for the cause, then reset the circuit breaker.	11.7
Nothing is displayed.	The screen is extremely dark.	Adjust the contrast.	10.6
	The screen is extremely cold.	Make sure that the ambient temperature is 5°C or higher.	–
Display is odd.	Instrument is abnormal.	Turn ON the power again.	–
Keys do not function.	Instrument is in remote mode.	Press the LOCAL key to activate local mode.	*
Measurement cannot be carried out.	Incorrect trigger level	Set the correct trigger level.	6.1
	No measuring channel is selected.	Check the measuring channels.	5.2 to 5.6
	Allowable measuring range is exceeded.	Check the measuring range.	5.2 to 5.6
	Incorrect arming	Check the arming setting.	6.3
	Incorrect inhibit	Check the inhibit setting.	6.4
	Incorrect reference signal.	Check the reference signal.	10.2
Data cannot be saved to a floppy disk.	Floppy disk has not been formatted.	When you are using a new floppy disk, it must be formatted.	9.2
	Floppy disk is not properly inserted into the floppy disk drive.	Insert it until the eject button pops up.	9.1
	Floppy disk is write-protected.	Remove write-protection.	–
	Insufficient space on floppy disk	Delete unnecessary files or use another floppy disk.	9.1, 9.2, 9.7
Data cannot be loaded from a floppy disk.	Floppy disk is not properly inserted into the floppy disk drive.	Insert it until the eject button pops up.	9.1
	Attempted to load data during measurement.	Stop or interrupt the current measurement, then load the data.	9.3, 9.4

* Refer to the GP-IB Interface User's Manual (IM704210-12E).

11.2 Messages

The following three kinds of message may appear on the screen.

- Error messages
  Displayed when an attempt is made to execute an operation which is not executable or when an abnormality occurs with the instrument.
- Warning messages
  Displayed when the instrument is in such a state that the user needs to be warned (e.g. when the measurement data overflows).
- Status messages
  Displayed to indicate the current state of the instrument. They are displayed at the bottom of the screen. (e.g. AUTO LOADING!)

This section describes the cause of each error message (except for communications related error messages) and the corrective action to be taken, in addition to the meaning of each warning message. For communications related error messages, refer to the GP-IB Interface User's Manual (IM704210-12E).

Error Messages

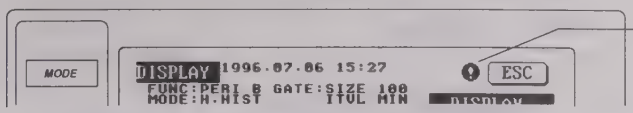
Error messages (except for those related to communications) are displayed in the center of the screen.

* Error messages related to communications are displayed in the error log window, like warning messages.

No.	Message	Reference Section
602	No disk inserted. No floppy disk is inserted in the floppy disk drive. Insert an appropriate disk.	9.1
604	Floppy disk isn't formatted. Floppy disk has not been formatted. Format it.	9.2
605	File not found. File does not exist. Check the file.	–
606	Disk is write-protected. Floppy disk is write-protected. Remove write-protection.	–
609	Same file already exists. A file with the same file name exists. Assign another name to the file and save it.	–
610	InValid file name. The filename is incorrect. Enter the correct name.	9.3, 9.4, 9.5
612	Disk is full. Floppy disk has insufficient space. Use a new floppy disk.	9.2
615	Disk format failure. Formatting of the disk failed. Format it again.	9.2
620	File access failure. An abnormality has occurred during access to the file. The file is probably damaged.	–
621	InValid data format. Data format is invalid. Check the file.	–
671	Measurement is in progress. It is not possible to access a file during measurement.	9.3, 9.4
672	Data to be saved don't exist. Data to be saved does not exist.	–
701	During output to plotter. It is not possible to operate the instrument during output to the plotter.	10.1
906	Fan stopped. Turn OFF the power immediately. Cooling fan has stopped. Turn off the power immediately.	–

Warning Messages

When a warning message(s) exists, the warning mark will appear on the top of the screen as shown below.



To display a list of warning messages, activate the error log window from the UTILITY top menu. If there are so many warning messages that they cannot be displayed on the screen at the same time (this is the case when warning messages include those related to communications), turn the rotary knob to scroll the messages. For how to scroll the messages, refer to 11.3.

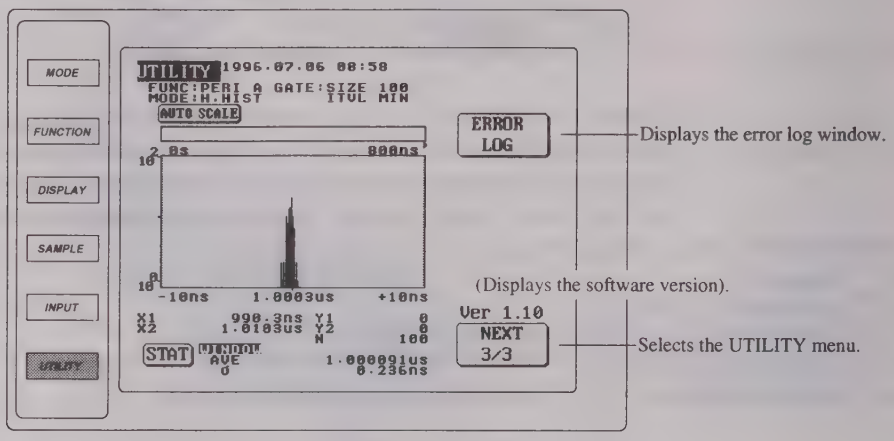
No.	Message	Reference Section
051	Time stamp data overflows. Time stamp data has over-flowed. 320 seconds have elapsed.	6.2
052	Measurement data overflows. Measurement data has over-flowed. The allowable measuring range was exceeded.	12.2

11.3 Using the Error Logging Function

Procedure

- To exit from the current menu, press any of the top menu keys.

UTILITY Top Menu

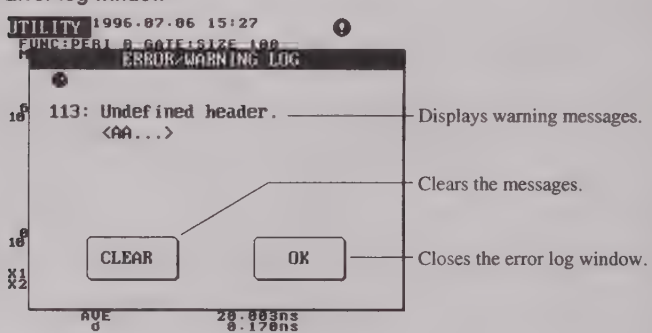


1. Press the UTILITY key to display the UTILITY top menu.
2. Press the NEXT touch key to display NEXT 2/3 on the key.

Displaying/clearing messages

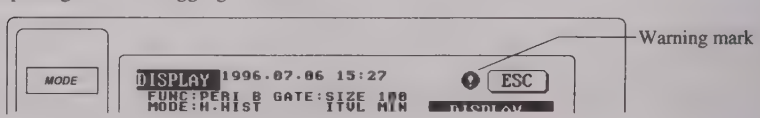
3. Press the ERROR LOG touch key to display the error log window.
4. If there are so many warnings messages that they cannot be displayed on the screen at the same time, turn the rotary knob to scroll the messages.
5. To clear the messages, press the CLEAR touch key.
6. To close the error log window, press the OK touch key.

Error log window



Explanation

If a warning message(s) or a communications related message(s) occurs, the warning mark will appear as shown below. In this case, you can refer to the message(s) whenever you want by opening the error logging window.



Note

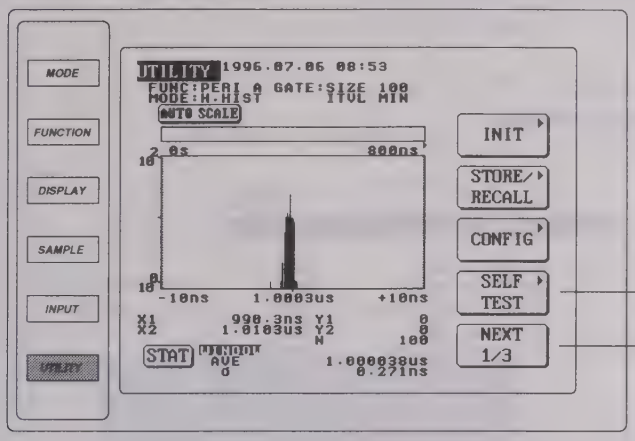
Communications related errors can be cleared by the above procedure. Warning messages will disappear automatically when the measurement is re-started and completed successfully.

11.4 Executing the Self-test

Procedure

- To exit from the current menu, press any of the top menu keys or press the ESC touch key displayed on the screen.

UTILITY Top Menu



1. Press the UTILITY key to display the UTILITY top menu.
2. Press the NEXT touch key to display NEXT 1/3 on the key.
3. Press the SELF TEST touch key to display the self-test menu.

Selecting board test

4. Press the BOARD TEST touch key to highlight BOARD TEST.

- **Executing board test**

5. Press the EXEC touch key. The board test will start and the results will be displayed. When the board test is completed, the ESC touch key will appear. If PASS does not appear for each test item, the instrument is faulty.

- **Returning to the self-test menu**

6. Press the ESC touch key to return to the self-test menu.

Selecting key/rotary knob test

7. Press the KEY TEST touch key to highlight KEY TEST.

- **Executing key/rotary knob test**

8. Press the EXEC touch key. The key/rotary knob test will start and the front panel view will appear on the screen.
9. Press each front panel key to check that the corresponding area highlights. Turn the rotary knob to check that the rotary knob icon rotates.

- **Returning to the self-test menu**

10. Press the ESC touch key to return to the self-test menu.

Selecting touch key test

11. Press the TOUCHKEY TEST touch key to highlight TOUCHKEY TEST.

- **Executing touch key test**

12. Press the EXEC touch key. Numbers 1 to 60 will appear on the screen.
13. Press each number to check that it highlights.

- **Returning to the self-test menu**

14. Press an any front panel key to return to the self-test menu.

Selecting display test

15. Press the DISPLAY TEST touch key to highlight DISPLAY TEST.

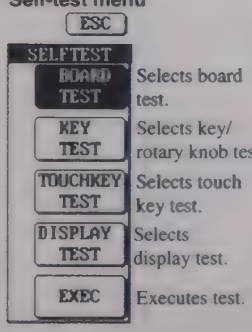
- **Executing display test**

16. Press the EXEC touch key. The entire screen will become bluish. Check that there are no white spots on the screen.
17. Use the arrow keys or rotary knob to check that the contrast changes accordingly.

- **Returning to the self-test menu**

18. Press an any front panel key except the arrow keys to return to the self-test menu.

Self-test menu



Explanation

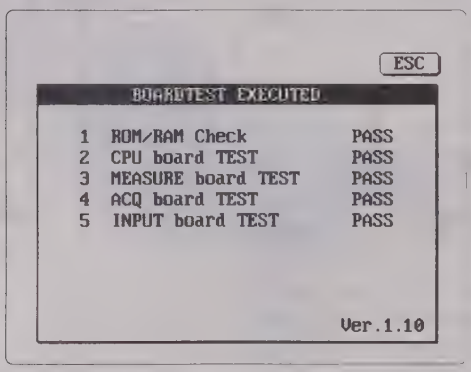
Remove all the cables connected to the terminal on the front and rear panels of the instrument. Make sure that no measurement is currently being carried out.

When an abnormality occurs during execution of a test item.

The instrument is faulty. Contact your nearest YOKOGAWA representative listed on the rear cover of this manual for repair.

Board test

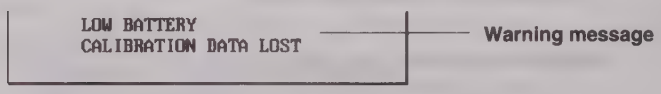
- **Display example**



- **When the following warning message appears during board test:**

If LOW BATTERY warning message appears, replacement of the lithium batteries is required. If CALIBRATION DATA LOST warning message appears, calibration data may have been lost. Thus, re-calibration is required.

Replacement of the lithium batteries and re-calibration should not be carried out by the user, so contact your nearest YOKOGAWA representative listed on the rear cover of this manual.

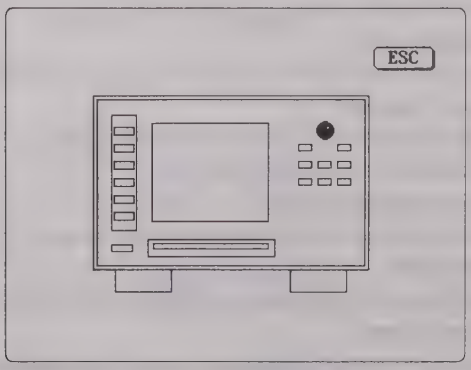


Note

An error may occur if board test is carried out during measurement.

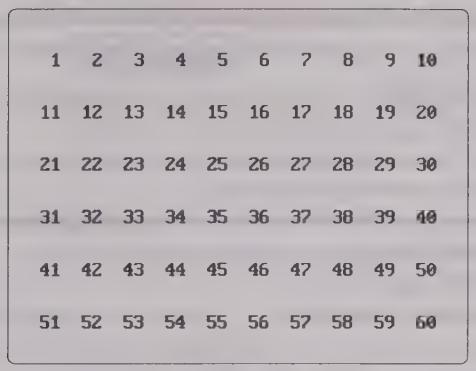
Key/rotary knob test

Display example



Touch key test

Display example



Display test

Display example

11.5 Adjusting the Time Base

CAUTION

- Never apply a voltage exceeding the maximum input voltage to the input terminals of the instruments. Damage to the input terminals may result.
- Never short-circuit the output terminals of the instruments or apply an external voltage to them. Damage to the internal circuits may result.

Instruments required

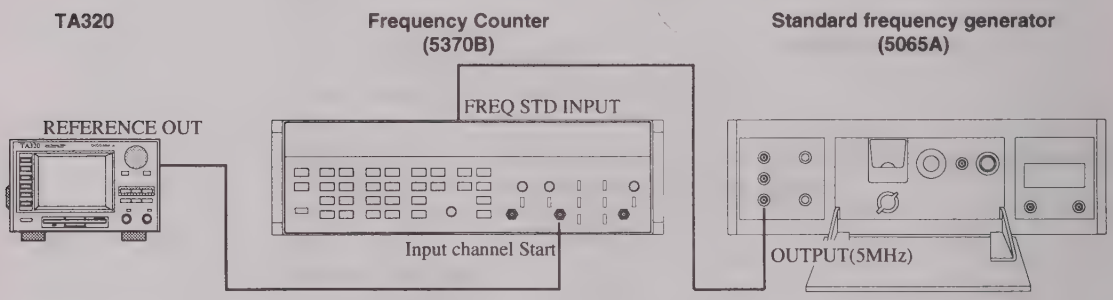
Prepare the following instruments.

- **Standard frequency generator**
  - Frequency accuracy: 0.1 ppm or better
  - Recommended instrument: 5065A (by HP)
- **Frequency counter**
  - Frequency resolution: 1 Hz or better
  - Recommended instrument: 5370B (by HP)

Adjustment method of time base (reference clock) using the above recommenced instruments is given below.

Connecting the instruments

- Make sure that the power to each instrument is OFF, then connect the instruments to each other as illustrated below.
- Connect the output of the standard frequency generator (5065A) to the FREQ STD INPUT (provided on the rear panel) of the frequency counter (5370B), and measure the frequency of the signal.
- Connect the REFERENCE OUT (provided on the rear panel) of the TA320 to the Input channel Start of the frequency counter (5370B).



Setting the instruments

- TA320: None
- 5370B:
  - Function: Frequency
  - Gating time: 0.01 s
  - Sample size: 1
  - Statistics: MEAN
  - Input channel Start: DC coupling, ÷1, 50 Ω, trigger level = PRESET, slope: ↑
  - FREQ STD: EXT
- 5065A: None

Adjustment method

- Wait for 30 minutes after the TA320 is turned ON.
- Turn the REF ADJUST (provided on the rear panel) of the TA320, to make sure that the reading of the frequency counter is within the following range.
  9.999990 MHz to 10.000010 MHz (10 MHz ±10 Hz, within ±1 ppm)

11.6 Carrying out the Performance Test

CAUTION

- Never apply a voltage exceeding the maximum input voltage to the input terminals of the instruments. Damage to the input terminals may result.
- Never short-circuit the output terminals of the instruments or apply an external voltage to them. Damage to the internal circuits may result.

Testing the Trigger Voltage Accuracy

Instruments required

Prepare the following instruments.

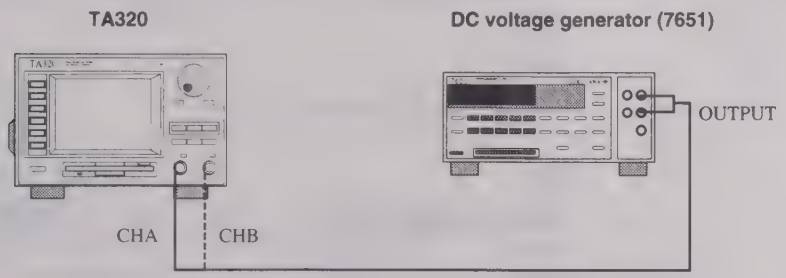
DC voltage generator

- Voltage accuracy: 1 mV or better
- Recommended instrument: Programmable DC voltage/current source 7651 (by Yokogawa)

Test method for trigger voltage accuracy using the above recommenced instruments is given below.

Connecting the instruments

- Make sure that the power to each instrument is OFF, then connect the instruments to each other as illustrated below.
- Connect the output of the DC voltage generator to the input terminal (CHA or CHB) of the TA320.



Setting the instruments

- TA320: Input settings: DC coupling, 1 MΩ, trigger level = 0V
- 7651: Output level : 4.000V
  : 2.000V
  : 0V
  : –2.000V
  : –4.000V

Note

If a noise is generated due to the environment, connect a capacitor (1 uF) between the signal cable and ground.

Testing method

- Wait for 30 minutes after the TA320 is turned ON.
- This test compares the input DC voltage to the trigger level set on the TA320, to test the trigger level tolerance.
- The trigger level is observed by monitoring the input indicator of the TA320.

Testing procedure

1. Connect the output of DC voltage generator (7651) to the CHA of the TA320.
2. Set the output level of the 7651 to 4.000 V.
3. Set the trigger level of the TA320 to 4.100 V.
4. Set the TA320 ready for measurement.
5. Decrease the trigger level in steps of 5 mV slowly. When the input indicator lights up, record the trigger level as VL.
6. Set the trigger level to 3.900 V.
7. Increase the trigger level in steps of 5 mV slowly. When the input indicator lights up, record the trigger level as VH.
8. Calculate the mean value of the VL and VH, and check that the mean value is within the allowable range.
   VTRIG = (VL + VH) / 2
9. Set the output of the 7651 to 2.000 C, 0 V, –2.000 V and –4.000 V at a time, and carry out the same test.
10. Repeat steps 1 to 9 for the channel CHB.

Test results

- CHA

Output voltage (7651)	VL	VH	VTRIG	Allowable Range
4.000V				3.83V to 4.17V
2.000V				1.91V to 2.09V
0.000V				–0.01V to 0.01V
–2.000V				–2.09V to –1.91V
–4.000V				–4.17V to –3.83V

- CHB

Output voltage (7651)	VL	VH	VTRIG	Allowable Range
4.000V				3.83V to 4.17V
2.000V				1.91V to 2.09V
0.000V				–0.01V to 0.01V
–2.000V				–2.09V to –1.91V
–4.000V				–4.17V to –3.83V

Testing the Input Sensitivity

Instruments required

Prepare the following instruments.

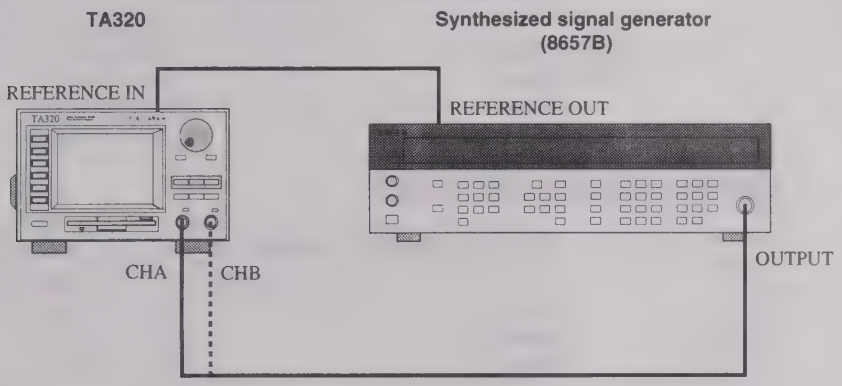
Synthesized signal generator

- Frequency range: 10 MHz to 50 MHz or higher
- Output level: 720 mV_{rms} or higher
- Output level accuracy: 1.5 dBm or better
- Recommended instrument: 8657B synthesized signal generator (by HP)

Test method for the input sensitivity using the above recommenced instruments is given below.

Connecting the instruments

- Make sure that the power to each instrument is OFF, then connect the instruments to each other as illustrated below.
- Connect the output of the synthesized signal generator to the input terminal (CHA or CHB) of the TA320.



Setting the instruments

- TA320:
  - Sampling mode : Hardware histogram mode
  - Input settings: DC coupling, 50 Ω (both CHA and CHB), trigger level = 0V
  - Function: Period A, B
  - Gate: Event, 1000000
  - Reference: External
  - X CENTER, X SPAN

Input Frequency	XCENTER	XSPAN
10MHz	100 ns	20 ns
20MHz	50 ns	20 ns
40MHz	25 ns	20 ns

  - Y HIGH: 10^6
- 8657B:
  - Frequency : 10MHz
    : 20MHz
    : 40MHz
  - Level : 35mV_{rms}

Testing method

- Wait for 30 minutes after the TA320 is turned ON.
- Set the frequency of the synthesized signal generator (8657B) to the values given in the table below, and check that the measured values (mean value and standard deviation) are within the allowable range using the period measurement function of the TA320. Carry out the same test for both channels CHA and CHB.

Test results

• CHA ↑

Frequency (8657B)	Avarage Value		Standard Deviation	
	Measured Value	Allowable Range	Measured Value	Allowable Range
10MHz		99.7 ns to 100.3 ns		480ps or less
20MHz		49.7 ns to 50.3 ns		390ps or less
40MHz		24.7 ns to 25.3 ns		340ps or less

• CHA ↓

Frequency (8657B)	Avarage Value		Standard Deviation	
	Measured Value	Allowable Range	Measured Value	Allowable Range
10MHz		99.7 ns to 100.3 ns		480ps or less
20MHz		49.7 ns to 50.3 ns		390ps or less
40MHz		24.7 ns to 25.3 ns		340ps or less

• CHB ↑

Frequency (8657B)	Avarage Value		Standard Deviation	
	Measured Value	Allowable Range	Measured Value	Allowable Range
10MHz		99.7 ns to 100.3 ns		480ps or less
20MHz		49.7 ns to 50.3 ns		390ps or less
40MHz		24.7 ns to 25.3 ns		340ps or less

• CHB ↓

Frequency (8657B)	Avarage Value		Standard Deviation	
	Measured Value	Allowable Range	Measured Value	Allowable Range
10MHz		99.7 ns to 100.3 ns		480ps or less
20MHz		49.7 ns to 50.3 ns		390ps or less
40MHz		24.7 ns to 25.3 ns		340ps or less

Testing the Frequency Resolution, Minimum Measured Value and Minimum Input Pulse Width

Instruments required

Prepare the following instruments.

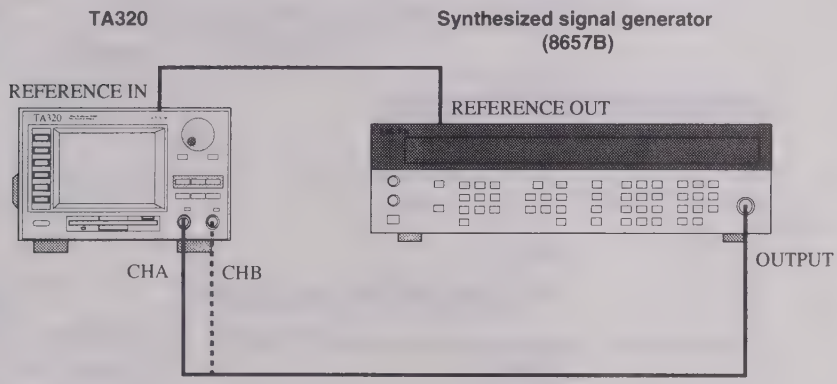
Synthesized signal generator

- Frequency range: 10 MHz to 50 MHz or higher
- Output level: 720 mV_{rms} or higher
- Output level accuracy: 1.5 dBm or better
- Recommended instrument: 8657B synthesized signal generator (by HP)

Test method for the input sensitivity using the above recommenced instruments is given below.

Connecting the instruments

- Make sure that the power to each instrument is OFF, then connect the instruments to each other as illustrated below.
- Connect the output of the synthesized signal generator to the input terminal (CHA or CHB) of the TA320.



Setting the instruments

- TA320:
  - Sampling mode: Hardware histogram mode.
  - Input settings: DC coupling, 50 Ω (both CHA and CHB), trigger level = 0V
  - Function: Period A, B
  - Gate: Event, 1000000
  - Reference: External
  - X CENTER, X SPAN

Input Frequency	XCENTER	XSPAN
10MHz	100 ns	20 ns
20MHz	50 ns	20 ns
40MHz	25 ns	20 ns
50MHz	20 ns	20 ns

  - Y HIGH: 10^6
- 8657B:
  - Frequency : 10MHz
    : 20MHz
    : 40MHz
    : 50MHz
  - Level : 360mV_{rms}

Testing method

- Wait for 30 minutes after the TA320 is turned ON.
- Set the frequency of the synthesized signal generator (8657B) to the values given in the table below, and check that the measured values (mean value and standard deviation) are within the allowable range using the period measurement function of the TA320. Carry out the same test for both channels CHA and CHB.
- If measurement using 50 MHz is possible, the minimum input pulse width can be tested.

Test results

• CHA↑

Frequency (8657B)	Avarage Value		Standard Deviation	
	Measured Value	Allowable Range	Measured Value	Allowable Range
10MHz		99.7 ns to 100.3 ns		320ps or less
20MHz		49.7 ns to 50.3 ns		310ps or less
40MHz		24.7 ns to 25.3 ns		300ps or less
50MHz		19.7 ns to 20.3 ns		300ps or less

• CHA↓

Frequency (8657B)	Avarage Value		Standard Deviation	
	Measured Value	Allowable Range	Measured Value	Allowable Range
10MHz		99.7 ns to 100.3 ns		320ps or less
20MHz		49.7 ns to 50.3 ns		310ps or less
40MHz		24.7 ns to 25.3 ns		300ps or less
50MHz		19.7 ns to 20.3 ns		300ps or less

• CHB↑

Frequency (8657B)	Avarage Value		Standard Deviation	
	Measured Value	Allowable Range	Measured Value	Allowable Range
10MHz		99.7 ns to 100.3 ns		320ps or less
20MHz		49.7 ns to 50.3 ns		310ps or less
40MHz		24.7 ns to 25.3 ns		300ps or less
50MHz		19.7 ns to 20.3 ns		300ps or less

• CHB↓

Frequency (8657B)	Avarage Value		Standard Deviation	
	Measured Value	Allowable Range	Measured Value	Allowable Range
10MHz		99.7 ns to 100.3 ns		320ps or less
20MHz		49.7 ns to 50.3 ns		310ps or less
40MHz		24.7 ns to 25.3 ns		300ps or less
50MHz		19.7 ns to 20.3 ns		300ps or less

Testing the Pulse Width Resolution and Minimum Measured Value

Instruments required

Prepare the following instruments.

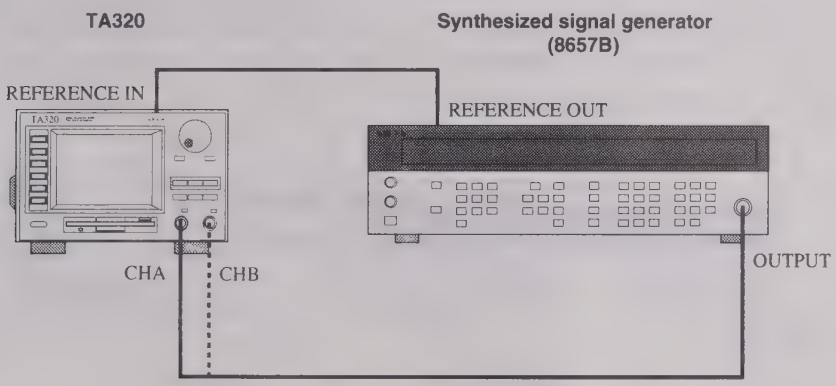
Synthesized signal generator

- Frequency range: 10 MHz to 50 MHz or higher
- Output level: 720 mV_{rms} or higher
- Output level accuracy: 1.5 dBm or better
- Recommended instrument: 8657B synthesized signal generator (by HP)

Test method for the input sensitivity using the above recommenced instruments is given below.

Connecting the instruments

- Make sure that the power to each instrument is OFF, then connect the instruments to each other as illustrated below.
- Connect the output of the synthesized signal generator to the input terminal (CHA or CHB) of the TA320.



Setting the instruments

- TA320
  - Sampling mode: Hardware histogram mode.
  - Input settings: DC coupling, 50 Ω (both CHA and CHB), trigger level = 0V
  - Function: Pulse width A, B
  - Gate: Event, 1000000
  - Reference: External
  - X CENTER, X SPAN

Input Frequency	XCENTER	XSPAN
10MHz	50 ns	20 ns
20MHz	25 ns	20 ns

  - Y HIGH : 10^6
- 8657B:
  - Frequency : 10MHz
    : 20MHz
  - Level : 360mV_{rms}

Testing method

- Wait for 30 minutes after the TA320 is turned ON.
- Set the frequency of the synthesized signal generator (8657B) to the values given in the table below, and check that the measured values (mean value and standard deviation) are within the allowable range using the the pulse width function of the TA320. Carry out the same test for both channels CHA and CHB.

Test results

- CHA

Frequency (8657B)	Avarage Value		Standard Deviation	
	Measured Value	Allowable Range	Measured Value	Allowable Range
10MHz		48.4 ns to 51.6 ns		320ps or less
20MHz		23.7 ns to 26.3 ns		310ps or less

- CHA

Frequency (8657B)	Avarage Value		Standard Deviation	
	Measured Value	Allowable Range	Measured Value	Allowable Range
10MHz		48.4 ns to 51.6 ns		320ps or less
20MHz		23.7 ns to 26.3 ns		310ps or less

- CHB

Frequency (8657B)	Avarage Value		Standard Deviation	
	Measured Value	Allowable Range	Measured Value	Allowable Range
10MHz		48.4 ns to 51.6 ns		320ps or less
20MHz		23.7 ns to 26.3 ns		310ps or less

- CHB

Frequency (8657B)	Avarage Value		Standard Deviation	
	Measured Value	Allowable Range	Measured Value	Allowable Range
10MHz		48.4 ns to 51.6 ns		320ps or less
20MHz		23.7 ns to 26.3 ns		310ps or less

Testing the A-to-B Interval Resolution

Instruments required

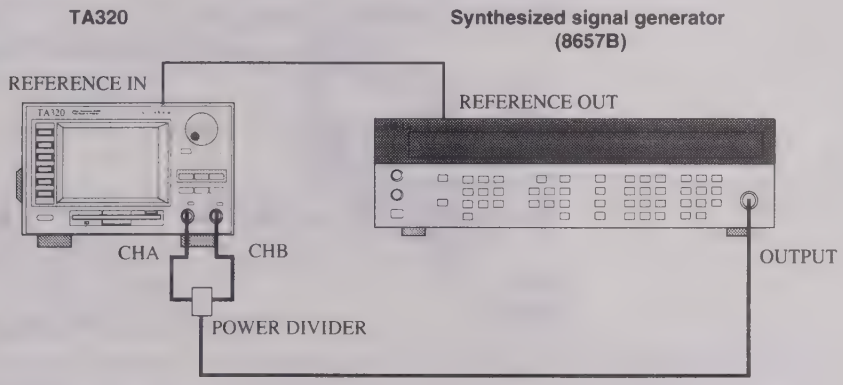
Prepare the following instruments.

- **Synthesized signal generator**
  - Frequency range: 10 MHz to 50 MHz or higher
  - Output level: 720 mV_{rms} or higher
  - Output level accuracy: 1.5 dBm or better
  - Recommended instrument: 8657B synthesized signal generator (by HP)
- **Power divider**
  - Characteristic impedance: 50 Ω
  - Recommended instrument: 700966 power divider (by Yokogawa)

Test method for the A-to-B interval resolution using the above recommenced instruments is given below.

Connecting the instruments

- Make sure that the power to each instrument is OFF, then connect the instruments to each other as illustrated below.
- Connect the output of the synthesized signal generator to the input terminal (CHA or CHB) of the TA320 via the power divider.
- The coaxial cable used between the power divider and input terminal (CHA) and that used between the power divider and input terminl (CHB) must have the same length.



Setting the instruments

- TA320:
  - Sampling mode: Hardware histogram mode
  - Input settings: DC coupling, 50 Ω (both CHA and CHB), trigger level = 0V
  - Function: A-to-B interval
  - Gate: Event, 1000000
  - Reference: External
  - X CENTER, X SPAN
    - When A↑ B↑ or A↓ B↓

Input Frequency	XCENTER	XSPAN
10MHz	100 ns	20 ns
20MHz	50 ns	20 ns

    - When A↑ B↓ or A↓ B↑

Input Frequency	XCENTER	XSPAN
10MHz	100 ns	20 ns
20MHz	50 ns	20 ns

  - Y HIGH : 10^6
- 8657B:
  - Frequency : 10MHz
    : 20MHz
  - Level : 720mV_{rms}

Testing method

- Wait for 30 minutes after the TA320 is turned ON.
- Set the frequency of the synthesized signal generator (8657B) to the values given in the table below, and check that the measured values (mean value and standard deviation) are within the allowable range using the time interval measurement function of the TA320.

Test results

- A↑ B↑

Frequency (8657B)	Avarage Value		Standard Deviation	
	Measured Value	Allowable Range	Measured Value	Allowable Range
10MHz		98.4 ns to 101.6 ns		320ps or less
20MHz		48.7 ns to 51.3 ns		310ps or less

- A↓ B↓

Frequency (8657B)	Avarage Value		Standard Deviation	
	Measured Value	Allowable Range	Measured Value	Allowable Range
10MHz		98.4 ns to 101.6 ns		320ps or less
20MHz		48.7 ns to 51.3 ns		310ps or less

- A↑ B↓

Frequency (8657B)	Avarage Value		Standard Deviation	
	Measured Value	Allowable Range	Measured Value	Allowable Range
10MHz		48.4 ns to 51.3 ns		320ps or less
20MHz		23.7 ns to 26.3 ns		310ps or less

- A↓ B↑

Frequency (8657B)	Avarage Value		Standard Deviation	
	Measured Value	Allowable Range	Measured Value	Allowable Range
10MHz		48.4 ns to 51.3 ns		320ps or less
20MHz		23.7 ns to 26.3 ns		310ps or less

11.7 Circuit Breaker

CAUTION

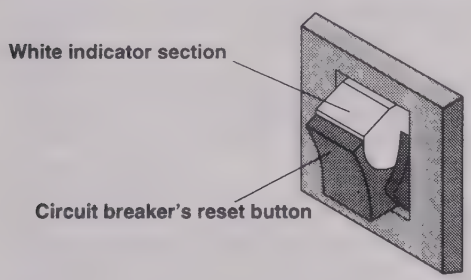
If the circuit breaker is activated to cause the power to be turned OFF, an abnormality has occurred with the internal circuitry. If the circuit breaker cannot be reset, do not try to reset it. Contact your nearest YOKOGAWA representative, listed on the back cover of this manual.

Location of the circuit breaker

A circuit breaker is provided on the rear panel of the instrument, instead of a power fuse, to protect the internal circuitry. For the location of the circuit breaker, refer to 2.2 "Rear Panel".

Function of the circuit breaker

If the instrument is over-loaded causing an excessive current to flow through the internal circuitry, the circuit breaker will be activated to cause the power to be turned OFF. In this case, the reset button of the breaker will pop up, exposing the white indicator section.



Resetting the circuit breaker

If the circuit breaker is activated and the power is turned off, wait approx. one minute, then push in the reset button to resume operation. If an over-load still occurs the trip-free mechanism will be activated, hindering the reset button from returning to the original position.

12.1 Measuring Inputs and Trigger

Item	Specification
Number of input channels	2 (CHA and CHB)
Input coupling	DC/AC
Input connector	BNC connector
Input impedance	50 Ω/1 MΩ, 20 pF (typical *1)
Frequency characteristic (-3 dB)	• DC input coupling: DC to 100 MHz (typical *1) • AC input coupling • 680 KHz to 100 MHz (typical *1) (Input impedance 50 Ω) • 35 Hz to 100 MHz (typical *1) (Input impedance 1 MΩ)
Internal jitter	300 ps (rms)
Minimum input pulse width	10 ns
Operating voltage range	–5 V to +5 V
Maximum input voltage	• Input impedance 50 Ω: $5V_{rms}$ • Input impedance 1 MΩ • 40 V (DC + AC_{peak}) (DC ≦ input frequency ≦ 100 KHz) • {3.5/f (MHz) + 5} V (DC + AC_{peak}) (100 kHz < input frequency ≦ 100MHz)
Input sensitivity *2	100 mV_{p-p}
Input amplifier noise	400 μV_{rms} (typical *1)
Trigger	• Trigger mode : Can be selected from single auto trigger, repeat auto trigger and manual trigger • Trigger level • Setting range: –5 V to +5 V (can be set using front panel keys for manual trigger mode) • Accuracy *2: ±(10 mV + 4% of predetermined value) • Resolution: 5 mV • Input signal condition: 1 kHz to 50 MHz (single auto trigger, repeat auto trigger) • Setpoint time: 0.7 s (typical *1) (single auto trigger, repeat auto trigger)
Sampling	• Sampling mode: Can be selected from time stamp mode and hardware histogram mode • Maximum sampling rate: Continuous 14 M samples/s (approx. 71-ns intervals) 7 M samples/s (approx. 142-ns intervals) in the case of duty ratio and phase difference measurements • Maximum sample size (maximum number of data items) • Time stamp mode: 32,000 (16,000 in the case of duty ratio and phase difference measurements) • Hardware histogram mode: 99,999,999 (excluding duty ratio and phase difference measurements) • Sampling interval MIN, 1 µs, 2 µs, 4 µs, 10 µs, 20 µs, 40 µs, 100 µs, 200 µs, 400 µs, 1 ms, 2 ms, 4 ms MIN is equivalent to the interval for the maximum sampling rate. Must be selected for time stamp mode only. • Maximum sampling time: 320 s (after the arming)

*1: Typical values are described in terms of typical of average performance. However, they cannot be guaranteed.

*2: Measured under the reference operating conditions specified in 12.10 "General Specifications", after elapse of warm-up time, with the DC input coupling and 1MΩ input impedance.

12.2 Measurement Functions (Measurement Items)

Items	Specifications
Measurement Update Rate *1	400 ms (hardware histogram mode only) (For measurement of period of 1-MHz sine-wave, with sample size of 1000)
Period	• Measuring range • 30 ns to 100 ms (time stamp mode) • 30 ns to 3.2 µs (hardware histogram mode) • Display resolution • 100 ps (time stamp mode) • 100 ps or histogram span setting/200, whichever larger (hardware histogram mode) • Measurement resolution *1 • ±300 ps rms ± $\sqrt{2}$ × trigger error *2 (time stamp mode) • ±300 ps rms or display resolution ± $\sqrt{2}$ × trigger error *2, whichever larger (hardware histogram mode) • Accuracy *1 ±300 ps rms ± $\sqrt{2}$ × trigger error *2 ±(timebase frequency stability × measured period) ±300 ps systematic error • Slope: Can be selected from ↑ and ↓.
Time Interval • A-to-B Interval	• Measuring range • 5 ns to 100 ms (time stamp mode) • 5 ns to 3.2 µs (hardware histogram mode) • Display resolution • 100 ps (time stamp mode) • 100 ps or histogram span setting/200, whichever larger (hardware histogram mode) • Measurement resolution *1 • Time stamp mode • When slope is A↑ B↑ / A↑ B↓ / A↓ B↑ / A↓ B↓ ±300 ps rms ±A-input trigger error *2 ±B-input trigger error *2 • When slope is A↕ B↑ / A↕ B↓ ±300 ps rms ±A-input trigger error *2 ±B-input trigger error *2 ±trigger level timing error *3 • Hardware histogram mode • When slope is A↑ B↑ / A↑ B↓ / A↓ B↑ / A↓ B↓ ±300 ps rms or display resolution, whichever larger ±A-input trigger error *2 ±B-input trigger error *2 • When slope is A↕ B↑ / A↕ B↓ ±300 ps rms or display resolution, whichever larger ±A-input trigger error *2 ±B-input trigger error *2 ±trigger level timing error *3 • Accuracy *1 ±300 ps rms ±trigger level timing error *3 ±(timebase frequency stability × measured interval) ±1-ns systematic error • Slope: Seletable from A↑ B↑ / A↑ B↓ / A↓ B↑ / A↓ B↓ / A↕ B↑ / A↕ B↓. • Condition for continuous measurement *1: Intervals between A-to-B measurements must be 30 ns or more and the period of CHA signal must be 71 ns or more.
• A-to-B-to-A Interval	• Measuring range • A to B: 30 ns to 100 ms, B to A: 30 ns to 100 ms (time stamp mode) • A to B: 30 ns to 3.2 µs, B to A: 30 ns to 3.2 µs (hardware histogram mode) • Display resolution • 100 ps (time stamp mode) • 100 ps or histogram span setting/200, whichever larger (hardware histogram mode) • Measurement resolution *1 • ±300 ps rms ±A-input trigger error *2 ±B-input trigger error *2 (time stamp mode) • ±300 ps rms or display resolution, whichever larger ±A-input trigger error *2 ±B-input timing error *2 (hardware histogram mode) • Accuracy *1 ±300 ps rms ±trigger level timing error *3 ±(timebase frequency stability × measured interval) ±1-ns systematic error • Slope: Selectable from A↑B↑A↑ / A↑B↓A↑ / A↓B↑A↓ / A↓B↓A↓.

Items	Specifications
Pulse Width	• Measuring range • 30 ns to 100 ms (time stamp mode) • 30 ns to 3.2 µs (hardware histogram mode) • Display resolution • 100 ps (time stamp mode) • 100 ps or histogram span setting/200, whichever larger (hardware histogram mode) • Measurement resolution *1 • Time stamp mode • When polarity is ⊣⌋/⌈⊢ ±300 ps rms ±rising trigger error *2 ±falling trigger error *2 • When polarity is ⊣⊢ ±300 ps rms ±rising trigger error *2 ±falling trigger error *2 ±trigger level timing error *3 • When polarity is **22T** ±300 ps rms ± $\sqrt{N}$ × (rising trigger error *2 + falling trigger error *2 + trigger level timing error *3), N indicates the number of edges which have passed during period of 22T. • Hardware histogram mode • When polarity is ⊣⌋/⌈⊢ ±300 ps rms or display resolution, whichever larger ±rising trigger error *2 ±falling trigger error *2 • When polarity is ⊣⊢ ±300 ps rms or display resolution, whichever larger ±rising trigger error *2 ±falling trigger error *2 ±trigger level timing error *3 • Accuracy *1 ±300 ps rms ±trigger level timing error *3 ±(timebase frequency stability × measured pulse width) ±1-ns systematic error • Polarity: Can be selected from ⊣⌋/⌈⊢/⊣⊢/ **22T**. **22T** can be selected for time stamp mode only.
Phase Difference (time stamp mode only)	• Measuring range: 0 to 360 deg (A to B: 71 ns or greater, B to A: 30 ns or greater) • Display resolution: 0.01 deg • Measurement resolution *1: ±(C/D – measured phase difference) C: Measured A-to-B interval + |measured A-to-B interval resolution| D: Measured CHA period – $\sqrt{2}$ × |measured A-to-B interval resolution| • Accuracy *1: ±(E/F – measured phase difference) E: Measured A-to-B interval + |A-to-B interval accuracy| F: Measured CHA period – $\sqrt{2}$ × |A-to-B interval accuracy| • Slope: Seletable from A↑ B↑ / A↑ B↓ / A↓ B↑ / A↓ B↓.
Duty Ratio (time stamp mode only)	• Measuring range: 0 to 99.999% (can be measured with pulse width of 71 ns to 100 ms) • Display resolution: 0.001% or 100 ps/period x 100%, whichever larger • Measurement resolution *1: ±(G/H – measured duty ratio) G: Measured pulse width + |measured pulse width resolution| H: Measured period – $\sqrt{2}$ × |measured pulse width resolution| • Accuracy *1: ±(J/K – measured duty ratio) J: Measured pulse width + |pulse width accuracy| K: Measured period – $\sqrt{2}$ × |pulse width accuracy| • Polarity: Can be selected from ⊣⌋ and ⌈⊢.

*1: Measured under the reference operating conditions specified in 12.10 "General Specifications", after elapse of warm-up time.

*2: The trigger error, A-input trigger error, B-input trigger error, rising trigger error and falling trigger error are represented by the following formula.

$$\frac{\sqrt{X^2 + E_n^2}}{S.R}$$

X: Noise of the input amplifier (100 MHz)
E_n: Noise on the signal being measured
S.R: Slew rate of the signal being measured (V/s)

*3: The trigger level timing error is represented by the following formula.

$$\pm\left(\frac{15\,\text{mV}}{\text{start signal's slew rate}} - \frac{15\,\text{mV}}{\text{stop signal's slew rate}}\right) \pm \frac{\text{trigger level setting accuracy}}{\text{start signal's slew rate}} \pm \frac{\text{trigger level setting accuracy}}{\text{stop signal's slew rate}}$$

12.3 Gate, Arming, Inhibit

Item	Specifications
Gating	• Type: Can be selected from EVENT, TIME and EXTERNAL. • Configurable number of events (within 320 s following the arming) • Time stamp mode • Period, time interval, pulse width measurements: 1 to 32,000 • Phase difference, duty ratio: 1 to 16,000 • Hardware histogram mode: 1 to 99,999,999 • Configurable gate time range (within maximum number of events for sampling mode) • 1 µs ≤ gate time < 5 ms (in 200 ns increments) • 5 ms ≤ gate time ≤ 10 s (in 1 ms increments) • Allowable time frame for external gate 1 µs to 320 s (within maximum number of events for sampling mode) • Polarity: Can be selected from ⎍ and ⎍.
Arming	• Arming source: Can be selected from AUTO (automatic) and EXT (external). • Arming delay (only when EXT is selected as the arming source) • Configurable delay time in the case of time delay • 1 µs ≤ delay time < 5 ms (in 200 ns increments) • 5 ms ≤ dalay time ≤ 1 s (in 1 ms increments) • Event delay: Can be set from 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 200, 300, 400, 500, 600, 700, 800, 900, 1000, 2000, 3000, 4000, 5000, 6000, 7000, 8000, 9000, 10000, 20000, and 30000. • Slope: Can be selected from ↑ and ↓.
Inhibit	• Allowable time frame: 1 µs to 320 s • Polarity: Can be selected from ⎍ and ⎍.

12.4 Display

Item	Specifications
Display	• Size: 4.7 inch • Device: LCD (liquid crystal display), resistance-film type touch screen (panel) • Display resolution: 320 dots (H) × 240 dots (V) • Display defect: 0.01% or less for the entire display pixels
Display format	• Time stamp mode Can be selected from histogram, list, time variation and statistic values. • Hardware histogram mode Can be selected from histogram, list and statistic values.
Histogram display (for time stamp mode)	• Scale: X-axis and Y-axis of histogram • X CENTER (center value of X-axis) setting range • Period, time interval and pulse width measurements: 10 ns to 99.9999900 ms • Phase difference measurement: 15.00 to 345.00 deg • Duty ratio measurement: 0.500 to 99.500% • X SPAN (span of X-axis) • Period, time interval and pulse width measurements: Can be selected from 2, 4, 10, 20, 40, 100, 200, 400 ns, 1, 2, 4, 10, 20, 40, 100, 200, 400 µs, 1, 2, 4, 10, 20, 40 and 100 ms. • Phase difference measurement: Can be selected from 30, 60, 90, 180 and 360 deg. • Duty ratio measurement: Can be selected from 1, 5, 10, 50 and 100%. • Y AXIS (Y-axis scale): Can be selected from LIN (linear scale) and LOG (logarithmic scale) • Y HIGH (maximum value of Y-axis) • LIN: Can be selected from 10, 20, 40, 100, 200, 400, 1000, 2000, 4000, 10000, 20000 and 32000. • LOG: Can be selected from 10^1, 10^2, 10^3, 10^4 and 10^5. • Readout: Markers can be used to read measured values present in the area enclosed by the two markers. • Calculation • AREA: Used to select the area to be used for statistical computation from WINDOW and MARKER. • CONST T: Used to set the constant T for statistical computation and pulse width measurement. Setting range: 10 to 999.9 ns
Histogram display (for hardware histogram mode)	• Scale: X-axis and Y-axis of histogram • X CENTER (center value of X-axis) setting range: 10 ns to 3.19 µs • X SPAN (span of X-axis): Can be selected from 2, 4, 10, 20, 40, 100, 200, 400 ns, 1, 2, and 3.2 µs. • W.SPACE (space between the center values of X-axis): 0 to 250 ns (AUTO multi-window mode only) • Y AXIS (Y-axis scale): Can be selected from LIN (linear scale) and LOG (logarithmic scale) • Y HIGH (maximum value of Y-axis) • LIN: Can be selected from 10, 20, 40, 100, 200, 400, 1000, 2000, 4000, 10000, 20000 and 40000, 10^5, 10^6, 10^7 and 10^8. • LOG: Can be selected from 10^1, 10^2, 10^3, 10^4, 10^5, 10^6, 10^7 and 10^8. • Readout: Markers can be used to read measured values present in the area enclosed by the two markers. • Calculation • AREA: Used to select the area to be used for statistical computation from WINDOW and MARKER. • CONST T: Used to set the constant T for statistical computation and pulse width measurement. Setting range: 10 to 999.9 ns • Multi-window: Enables data analysis for more than two histograms. • Multi-window function can be turned ON and OFF. • Configurable number of windows (window size): 1 to 16 • Multi-window mode: Can be set from AUTO and MAN. • Panorama display: Enables the user to observe the overall view of histograms. • Panorama display can be turned ON and OFF. • Selection panorama area: The range of 0 to 3.2 µs can be divided into 4 sections.
Histogram data addition (available only when multi-window is ON, AUTO multi-window mode and hardware histogram mode selected)	The frequency of each corresponding bin of the windows (histograms) specified for multi-window setting is added around their center value of X-axis.

Item	Specifications
Time variation display (time stamp mode only)	• Scale: X-axis and Y-axis of time variation • X MIN (minimum value of X-axis): 0 to 199.9999800 sec. • X SPAN (maximum value of X-axis): Can be selected from 20, 40, 100, 200, 400 µs, 1, 2, 4, 10, 20, 40, 100, 200, 400 ms, 1, 2, 4, 10, 20, 40, 100 and 200 sec. • Y CENTER (center value of Y-axis) • Period, time interval and pulse width measurements: 10 ns to 99.9999900 ms • Phase difference measurement: 15.00 to 345.00 deg • Duty ratio measurement: 0.500 to 99.500% • Y SPAN (span of Y-axis) • Period, time interval and pulse width measurements: Can be selected from 2, 4, 10, 20, 40, 100, 200, 400 ns, 1, 2, 4, 10, 20, 40, 100, 200, 400 µs, 1, 2, 4, 10, 20, 40 and 100 ms. • Phase difference measurement: Can be selected from 30, 60, 90, 180 and 360 deg. • Duty ratio measurement: Can be selected from 1, 5, 10, 50 and 100%. • Readout: Markers can be used to read measured values present in the area enclosed by the two markers. • Display parameters: Grid and interpolation displays can be turned ON and OFF. • X-axis resolution (time stamp mode): 100 ns
List display (time stamp mode)	A list of time stamps and their measured values is displayed. • Displayed data can be scrolled up and down. • Resolution for time stamps: 100 ns
List display (hardware histogram mode)	A list of measured values (class values of histogram) and their frequency is displayed. Displayed data can be scrolled up and down.
Statistics display (time stamp mode)	A list of statistic values for the area specified for histogram display calculation setting is displayed. Statistical computation items *: Maximum value, minimum value, mean value, standard deviation, peak to peak, flutter
Statistics display (hardware histogram mode)	A list of statistic values for the area specified for histogram display calculation setting is displayed. • Statistical computation items *: Maximum value, minimum value, mean value, standard deviation, peak to peak, flutter, jitter 1, jitter 2 • Standard deviation is displayed in bar graph. Bar graph range: Can be selected from 7.5, 15, 30 and 60 ns.

*: Statistic values in the case of ⊣⊢ selected as the polarity for pulse width measurement with , and ⊣⊢ selected as the polarity for the calculation menu.

- Maximum, minimum, average, peak to peak, flutter, jitter 2: Not computed.
- Standard deviation, jitter 1: Standard deviation and jitter 1 are computed, individually for positive and negative sides, then the sum of computed standard deviation and that of computed jitter 1 are divided by 2.

12.5 Inputs/Outputs (Rear Panel)

Item	Specifications
External arming input (shared with the external gating input)	• Connector type: BNC • Input coupling: DC • Input impedance: 10 kΩ (Typical *1) • Trigger level: TTL level • Maximum input voltage: –8 V to 13 V (DC + AC_{peak}) • Minimum pulse width: 30 ns • Setup time: 70 ns (in order for the gating signal to be valid, it must precede the measurement signal by no less than 70 ns)
Inhibit input	• Connector type: BNC • Input coupling: DC • Input impedance: 10 kΩ (Typical *1) • Trigger level: TTL level • Maximum input voltage: –8 V to 13 V (DC + AC_{peak}) • Minimum pulse width: 30 ns • Setup time: 70 ns (in order for the inhibit signal to be valid, it must precede the measurement signal by no less than 70 ns)
Reference input	• Connector type: BNC • Input coupling: AC • Input impedance: 1 kΩ min. • Input frequency range: 10 MHz ±10 Hz • Input voltage level: 1 V_{p-p} min. • Maximum input voltage: ±10 V
Reference output	• Connector type: BNC • Output coupling: AC • Output impedance: 50 Ω (Typical *1) • Output frequency: 10 MHz (Typical *1) • Output voltage level *2: 1 V_{p-p} min.
Monitor output (CHA/CHB)	• Connector type: BNC • Output impedance: 50 Ω (Typical *1) • Output voltage level (*2): Approx. 1/4 of the measuring input signal (within ±5 V)

*1: Typical values are described in terms of typical of average performance. However, they cannot be guaranteed.
*2: Indicates the output level when the output is received by input impedance of 50 Ω.

12.6 GP-IB Interface

Item	Specifications
Interface	GP-IB
Electrical and mechanical specifications	Conforms to IEEE Standard 488-1978.
Functional specifications	SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT0, C0
Protocol	Conforms IEEE Standard 488-1978.
Code	ISO (ASCII) code
Mode	Addressable mode/talk-only mode
Address setting	0 to 30
Remote mode clear	Remote mode can be cleared by pressing the LOCAL key on the front panel. However, this is not possible if Local Lockout has been set by the controller.
Plotter output	Outputs the screen image data.

12.7 Time Base

Item	Specifications
Internal reference frequency (clock)	10-MHz temperature-compensated crystal oscillator
Frequency stability	Aging rate: ±1.5 ppm/year Temperature characteristics: ±2.5 ppm over 5 to 40°C (with +25°C as the reference)
External adjustment	Available

12.8 Internal Memory Function

10 sets of set-up information can be stored in the nonvolatile memory and recalled from it.

12.9 Built-in Floppy Disk Drive

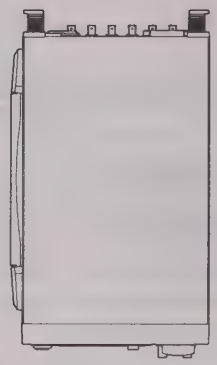
Item	Specifications
Drive type	3.5-inch floppy disk
Number of drives	1
Format type	640 KB/720 KB/1.2 MB/1.44 MB (MS-DOS compatible)

12.10 General Specifications

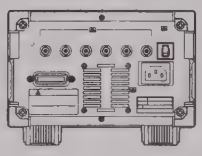
Item	Specifications
Standard operating conditions	• Ambient temperature: 23 ±2°C • Ambient humidity: 50 ±10% RH • Supply voltage/frequency: Within 1% of the rated voltage/frequency
Warm-up time	Approx. 30 minutes
Storage environment	• Temperature: –20 to +60°C • Humidity: 20 to 80% RH (no condensation allowed)
Operating environment	• Temperature: 5 to +40°C • Humidity: 20 to 80% RH (no condensation allowed)
Rated supply voltage	100 to 240 VAC
Permitted supply voltage range	90 to 264 VAC
Rated supply voltage frequency	50 to 60 Hz
Permitted supply voltage frequency range	48 to 63 Hz
Power consumption:	125 VA max.
Withstand voltage (between power supply and case)	1.5 kVAC, for 1 minute
Insulation resistance (between power supply and case)	10MΩ min. at 500 VDC.
Signal ground	All the input/output connectors must be grounded to the case.
External dimensions: Approx.	213 (W) × 132 (H) × 350 (D) mm, excluding projections
Weight	Approx. 5 kg (main unit only)
Cooling method	Forced air cooling
Installation position	Horizontal (Placing instruments one on top of the other is not allowed.)
Battery back-up	Set-up information and clock data are backed-up by internal lithium batteries.
Standard accessories	• Power cord: 1 • Rubber foot: 2 • User's Manual: 1 (this manual) • GP-IB Interface User's Manual: 1

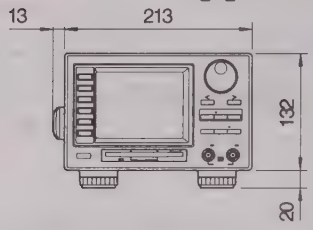
12.11 External Dimensions

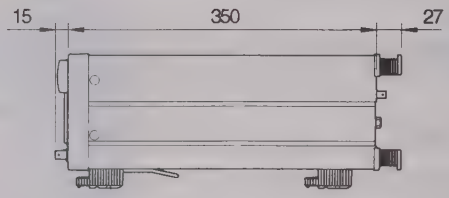
Unit: mm



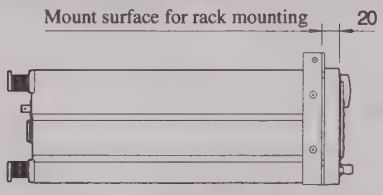
Rear view

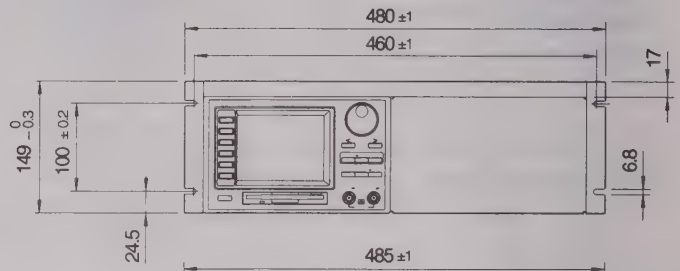


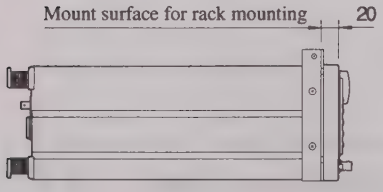


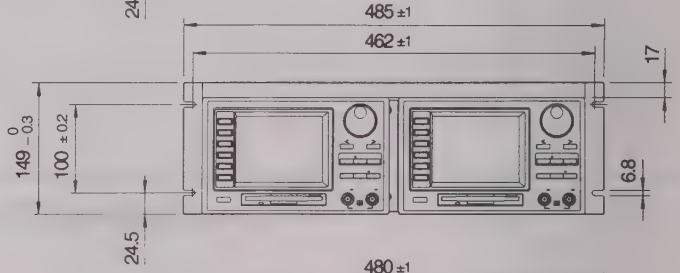


○ JIS rack mount dimensions

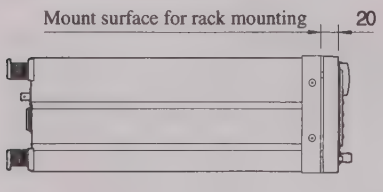


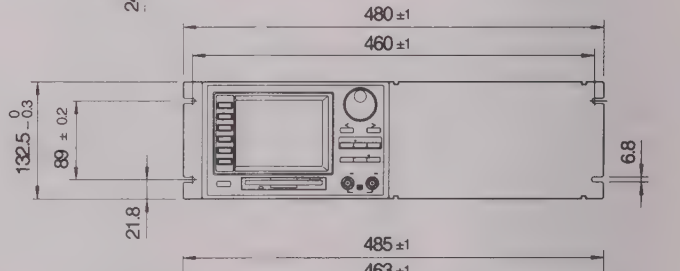


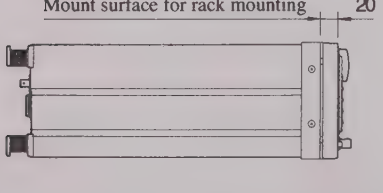


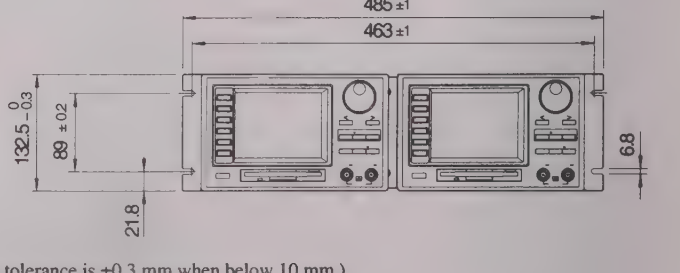


○ EIA rack mount dimensions









Unless otherwise specified, tolerance is ±3%. (However, tolerance is ±0.3 mm when below 10 mm.)

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Feb. '96

Printed in Japan , 612(YG)